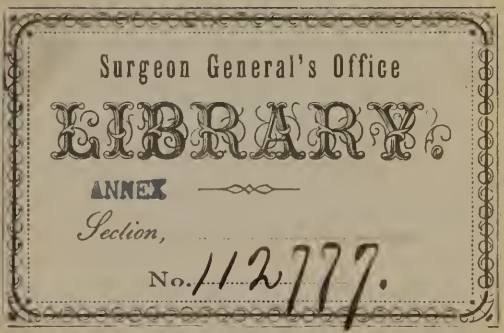

[Bentley (Joseph)]

HEALTH

MADE EASY

FOR THE PEOPLE;

OR,

Physical Training,

TO MAKE THEIR LIVES, IN THIS WORLD, LONG AND HAPPY.

BY THE

INVENTOR OF THE "PLANO-TERRESTRIAL GLOBE;"
AUTHOR OF A "TREATISE ON THE GLOBE,"
"MODERN GEOGRAPHY,"
"EDUCATION: AS IT IS, OUGHT TO BE, AND MIGHT BE," ETC. ETC

FIRST AMERICAN EDITION.

WITH ADDITIONS.

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TO

CHARLES HINDLEY, ESQ., M.P.

My Dear Friend,

With your very courteous permission, these humble pages, designed to do good, are most respectfully inscribed as a small testimony of the admiration in which the uniform devotion of your talents, wealth, and personal influence, as a Christian, citizen, and senator, to the noble purpose of improving and extending Education among the People, is held by your deeply grateful

and very humble servant,

THE AUTHOR.

PREFACE

TO THE THIRD EDITION.

No event in my life has yet been more fraught with unmixed pleasure, than my being called on, thus early, for a third Edition of this Work. I find it universally admitted, "that if this cheap book could be introduced at once into all our schools, and the rising generation, in every rank of life, taught to read, study, and practise the plain, simple rules it contains, they would become far more healthy, and enjoy longer life than their forefathers." And what hinders this from being done? Who would not struggle hard to remove every difficulty out of the way?

During the last quarter of a century, human life has been considerably prolonged in Great Britain, by various causes. I believe there is no reason why its average duration should not be still further increased ten or fifteen years, except man's own ignorance, neglect, or disobedience. To remove these, in some measure, I have included every law and condition on which health, long life, and happiness can be secured by man, in the following work; and am devoting all my time and humble talents to introduce it into universal use, throughout the British Isles.

Fortunately, none of us need to wait till everybody else becomes wise, good, and happy; for we can each have our share of these blessings *now*, if we are willing to comply with all the laws and conditions on which they are bestowed, and not otherwise. Let me, then, ask most affectionately, what hinders any parent or teacher from taking up this as a practical subject of education along with the usual branches, if they really

desire the body, mind, and spirit of those children under their care to grow as vigorously, and become as strong, active, and healthy, as their original constitution will admit?

Every thing I can do is done, and shall be done, to carry on and complete this good work; and, should I be spared three or four years longer, I hope to be in a position to prove, that, if any children in the United Kingdom are then not being taught how to live long and be happy, it is not my fault. I could not sleep, if I neglected my duty in this matter; and yet I meet with some really good people who regard it with apathy or indifference. They seem to forget that the physical and mental laws of our nature discovered by science are as much God's laws as if he had revealed them to man in his written Word; which seems to be chiefly intended to make known to us truths, principles, and laws we never could find out, and not such as we possessed full means of discovering and applying for ourselves.

Revealed truth tells us, through the intellectual powers, what to do and why it should be done, while discovered truth, in all cases, confirms this by the aid of the senses, the reason, and the understanding. I believe all God's laws ought to be known and obeyed by every one—that man's ignorance, prejudice, or wilful blindness will not make the slightest change in any of them, be it revealed or natural; and to teach these doctrines in love is the delightful self-imposed duty of

JOSEPH BENTLEY.

INTRODUCTORY PREFACE.

For several thousand years the wise, good, and holy teachers of man, have been pressing on his attention the necessity of gaining *self-knowledge*, in their oral lessons, sublime, inspired essays, and learnedly written folios. And yet we have nearly reached the middle of the 19th century, without so much as preparing plain elementary books, from which to teach self-knowledge, *Physical*, *Religious*, *or Moral*, and the laws on which it is founded. Indeed, we seem anxious to teach every thing in our schools but this kind of knowledge.

Who that has reached the age of forty or fifty cannot remember many facts they have acquired by mere accident, about the laws affecting, in an important degree, their well-being? and how much of bodily or mental suffering they might, humanly speaking, have escaped, had this knowledge been given them as a part of their education? Besides, the early habit of obeying a law makes its observance so much more easy and pleasant in after-life.

From a thorough examination of all classes of schools, I find, that, of the total number of pupils passing through them, only one in thirty attempts to learn any thing beyond reading, writing, arithmetic, or

sewing; and, in most cases, these are taught in such a dogmatical, unintellectual way, that the thinking and reasoning powers of the learners are scarcely awakened, much less cultivated. And yet we hear complaints of the little influence education has on the conduct; though it would be well to ask those who thus look for "figs on thistles," how it is possible for an education that does not plant good thoughts and opinions to yield a crop of good words and deeds?

In some degree to remove these fatal errors in education, I propose, under the Divine blessing, to write a series of books, on subjects not hitherto taught systematically in our best schools, but a knowledge of which is generally agreed to be as necessary in forming a dutiful, well-regulated, and happy life, as food is for forming a strong, healthy body. All of them will be on nearly the same plan, stating, in as few and as simple terms as possible, the various LAWS our Great, Good, and Wise Creator stamped on matter, mind, and spirit—on man, and on society; with the duties, responsibilities, &c., connected therewith. This, the first book of the series, is intended to be used in either of the following ways.

In schools and families using this as a class-book, the best plan will be for each learner to read, in the usual way, a sentence or section carefully, till a sufficient portion has been thus read for one Lesson, and then the teacher should examine them on what they have read, from the Key, pp. 135 to 166. In cases where a new class-book cannot be introduced, how-

ever small its price may be, the teacher should read over a few sections carefully, two or three times, to the learners, and then question them on what he has read. On asking any question from the Catechism, all the learners who are prepared to answer should hold forth their right hands, the teacher selecting some one from that number to give the answer; and, if it be not satisfactory, a second or a third learner may afterwards be called upon.

But the chief good done by the giving of these Lessons, depends on the spirit in which they are taught. The teacher must constantly keep up the feeling in the minds of the learners, that God speaks to them, by these *His* just and unalterable laws, which it is their highest earthly interest to know and obey. "Laws," the teacher may say, "by which your health, growth, life, yea, your happiness, are governed; laws that I cannot alter, suspend, or obey for you—that have been, and are now, operating in and upon you, and will continue to do so while you live, whether you or I will or no, and whether we know them or not!

"Strange, and even hard, as this may appear to you at first, you will find that the more you get to know about these laws, the more strongly will the conviction become in your minds, that they could not be altered now for the better; and that one of the greatest blessings God has conferred on man is, that of not being able to alter or suspend the physical laws of his nature. I say to you most earnestly and affectionately, get to know them and obey them; because, if you do

not, you will be almost certain to suffer much in this life for neglecting to get this knowledge, which suffering will now be increased, when you remember that you could have been taught and would not. Whether you are rich or poor, these laws affect you the same, and obeying them is the only *sure* road to earthly happiness."

In speaking to children or young persons on detecting any breach of the physical laws, no word or look should be employed that could convey an idea of the corrector having any personal interest in the matter, beyond a benevolent wish for the health, comfort, and happiness of the young person corrected. These breaches should all be treated as matters between the all-seeing Creator and the frail, but still responsible breaker of the law. Our business should be to present the consequences of these breaches so clearly and strongly, that they would be really felt, however remote they might be. God's laws should not be merely repeated as precepts by the tongue, but clearly understood by the mind, as unalterable principles.

I am induced to press these plans and suggestions the more earnestly and confidently, from the result of my own experience, in giving the Lessons to all classes of learners, from the unfortunate children in our union workhouses, up through every grade of schools, to the most respectable and enlightened academies and seminaries. It always seemed to me as though the eyes of the young people were opened to see an entirely new world, in which they had been all their lives without seeing it; and was generally accompanied by

evident regret, that they could not be made more fully acquainted with facts and laws which so much concerned themselves.

Objections were formerly made to giving this kind of physical instruction to the young; but, rightly considered, there will be found, perhaps, the strongest arguments in favour of giving this knowledge. It was said, that "to teach children how to take care of their health in this manner, would be to set them to think on it, to the exclusion of almost every other subject." But the objectors forgot, if they ever knew the fact, that we always think least about those things we know best. While, for instance, we know little of the spelling of words, we have to stop and think how to spell very many of those by which we want to put our thoughts on paper, and, with all our thinking, often make blunders that cause others to laugh at us. But it is not so when we know how to spell; for the right letters in each word seem to flow from the pen's point, as if by instinct, the mind being almost entirely engaged with the thoughts we want to write; and this is the case in every thing we learn through life.

All experience proves, that wherever self-knowledge is not engrafted in the young mind, that mind is left destitute of the most effectual human aids to ensure correct conduct in life, however good and useful the other learning given may be. Instead of attributing the errors of those who have received what is called a good education to their learning, we ought to ascribe such errors to their teachers *not* having taught them

to know, and trained them to do, those things that would have been the best safeguards under temptation, either from within or without. Believing that sufficiently enlightened and practical views of education have dawned on the public mind already, to make such a work as this acceptable with a large portion of those interested in training the growing minds of British youth, I will offer no further apology for its appearance as the first of a series of plain, simple, cheap books, designed to do good; and, praying for the Lord's blessing on these humble efforts to promote the study of His laws, that, being *known*, they may be OBEYED, it is thus sent forth by the public's most humble and grateful servant,

THE AUTHOR.

HEALTH MADE EASY.

LESSON I.

On God's Works and Laws.

1. God made every thing by his word, saying, "Let there be light," "Let there be a firmament," "Let the dry land appear," "Let us make man in our own image;" and every thing came into being as he commanded. All living and all dead bodies, every solid and every fluid substance, all animals, vegetables, earths, minerals, water, air, light, heat, belong to him, having been made by him; and will continue to exist according to his will, and the unchanging laws and principles he has seen fit to implant in their nature, so long as he pleases; "and he doeth with them as seemeth him good."

2. God's works differ from those of man in many things. They were created from *nothing*, while man requires *materials* from which to form his works. All things that came into being at God's command, did so with certain laws, or conditions of their existence attached to them in a manner not to be separated.

3. In the beginning of time, every thing belonging to the earth was drawn, or attracted towards the earth's centre, so that solid matter could not fly off into the space in which the earth moves round the sun in her annual orbit. The earth turned round on her axis, and the sun appeared to rise every morning, and set every evening. If seed was put in the ground at the proper season, it grew up, became ripe, and if not reaped, the plant then decayed. These

things, and ten thousand others, are the same now as then, and will be while the world endures.

4. Our first parents could not live without food—after their fall they had to labour, to procure food; and when they had eaten till they were satisfied, they were soon hungry again; their garments would not last for ever, nor could they make any thing without being first provided with materials. We know well these physical laws equally affect us, though nearly six thousand years have passed away.

5. When man has discovered, and made himself well acquainted with any of God's physical laws, he has then obtained an unerring guide by which to regulate his actions. The state of knowledge is such now, that man can tell the time when the sun will rise or set on any day, or the tide ebb and flow; he knows that seed-time goes before harvest, and that food cannot be obtained without labour of some kind or another. Modern science has discovered that light can be conveyed under ground in pipes many miles—that ships can be made to move on the water against wind and tide—carriages to run thirty, or even sixty miles an hour, and by the electric telegraph, a message can be sent three hundred or four hundred miles in a minute.

6. But the men who make discoveries, do not *make* things *to be* as they find them to be; they do not add any natural property to matter, nor do they create those faculties of their own minds, which were the chief means of their discoveries. Solomon says truly, "there is nothing new under the sun." These wise men make known to their fellow-men who will take the trouble to learn, means of happiness they did not know before; but they *create* no new law, the materials they employ, and the new way of applying them, have always been the same.

7. God created all material things with every power and means for giving happiness to man yet discovered, or that may hereafter be brought to light, implanted in their very nature. Man cannot create any new faculty in his own mind, however much he may improve those given him by his Maker. God never confers on man the worldly advan-

tages developed by scientific discoveries, till after they are made and brought into use. It is, therefore, difficult to conceive *why* all his physical laws were created and formed so well suited to make man comfortable here, if they are *not to be* discovered and applied, as man cannot obey them, if he does not know them. See sec. 212 to 216.

8. The lower animals obey the physical laws of their nature from instinct; and if man were to do the same, without ever exercising his reason and his mental powers upon them, he probably might lay claim to equal merit with those animals, as far as this world is concerned. Doing things from instinct, or merely from being told to do them, is not the way to train the reasoning powers of the mind.

9. Man would thus appear to act more in accordance with his position, his endowments, and his destiny; when he thoroughly investigates, clearly understands, and constantly obeys, *all* the laws of his Creator. And so when he finds out any new law, he does good to his fellow-men by leading them into new ways of enjoying already created blessings.

10. When man finds out any of God's physical laws, he is fully convinced that "they never tire or stop to rest," but are always the same. He has no fear that a hollow vessel will not float in any water; that food will not satisfy his hunger if he can get it, and water his thirst; or of ever being drunk, if he takes no alcoholic drink.

11. But he finds his own laws very different. Even when made in the best manner, and by the most wise and experienced legislators, human laws remain a dead letter on the statute book, if not carried into effect by human agency; and whenever that agency ceases, the law ceases to act also.

12. God's works, and the laws he has stamped on matter, mind, and spirit, must then form an important object of study with every human being who wishes to obey his Maker; or who desires to know all those things it is needful he should know, in reference to this world. Man is born without knowledge; his ignorance should therefore be removed, by a careful culture of all the powers of his mind.

13. But however well any man may know all these laws, he receives no benefit except from *obeying* them. Indeed, the knowledge possessed will add much to the punishment arising from any disobedience, because the sufferer will feel a conscious guilt increase his misery.

LESSON II.

On Dead Matter and Living Beings.

14. Every thing God created may be classed in one of two great divisions—animate or inanimate. All have life, or are without life. The tree, shrub, or plant, has life ; and feeds on or is nourished by the soil, the dews of heaven, the atmosphere, and the rays of the sun. Every plant has a natural power within it, by which these surrounding elements are imbibed, and become part of itself.

15. A piece of wood, a stone, or a lump of iron, has no such power. A table or chair cannot feed on the elements near it, and grow larger. The stone or pebble, washed down from the hills, though at first of rough, unshapen form, with its many edges and corners, is rolled about by the current, along with many others, till it becomes as smooth as an egg, and nearly of the same form.

16. Iron, hard as it is, wears away in the same manner ; —a piece three inches broad, and half an inch thick, nailed on the outer edge of a constantly used coach or cart wheel, is found, in a comparatively short time, to become little thicker than a penny.

17. These, and similar substances, have no power to take up new matter, by which to grow larger ; or even to supply those parts that wear away. They are mere passive substances, and this is the case with all inanimate matter. But not so with animated beings. Vegetables grow out of, or feed upon, inanimate matter, which, on being imbodied with them by the laws of *vegetable* life, become animated.

Animals feed upon and digest vegetables: which by the laws of *animal* life, become part of their bodies, for promoting their growth, and, after they attain maturity, supplying the waste caused by action, thus preventing for a time their decay.

18. Man stands at the head of all animated beings on the earth; and he alone has the power of searching into, and understanding, the laws of his own existence, and that of all other creatures. When he knows the laws which regulate all these changes, he sees a *little* of the wisdom, goodness, mercy and power of Him who created all things, and the unerring laws by which they are upheld. He knows that the natural power and constancy of those laws and principles depend not on his fellow man.

19. However one man may deprive another of the benefit he ought to receive for obeying these laws, they are still the same, and can never be changed or destroyed by human agency. When man, therefore, has made himself acquainted with any of the never-changing laws of God already known by his fellow men, he has extended the means of his own happiness. And, if he carefully apply himself to examine nature, in any of her numerous departments, and discovers a principle not known before, or a better application of those already known, he increases the means of earthly happiness for his species.

20. No branch of human knowledge can be of more importance to man, than that relating to his own physical body. At least this must be the case with all who really desire to be as happy and as free from pain here, as circumstances will permit. This knowledge at present is, to a great extent, beyond the reach of most people, from its being contained in very expensive books, and expressed in difficult scientific language, or hard words. It is true, several praiseworthy attempts have lately been made to remove these hindrances; but the works are chiefly suitable for adults, and the subject is treated in them merely as a science.

21. The laws of man's physical nature are more active in youth, and the consequences of disobeying those laws

then are more calamitous and irreparable, than at any other period of life. Self-denial of present pleasure is necessary, to avoid future evil, and ensure the enjoyment of happiness; and we have to bridle many of our strongest feelings and passions while complying with the laws stamped on our physical nature by the Almighty; and youthful ardour is generally opposed to these yokes.

22. As *sane* minds are found to submit to present restraints, in proportion as they have been taught to perceive the ultimate good of doing so, and are *trained* to do as they have been thus taught; we shall endeavour, in the following Lessons, to explain the great principles of our bodily structure, and the laws which regulate its vigorous growth, healthy action, and lengthened existence, in as clear and as simple a manner as the subject will admit.

23. Let the chief object in connection with each law be clearly to understand it; and gain a lasting idea of the benefit resulting from its observance, and the ill consequences certain to follow its non-observance, whether from ignorance or culpable neglect. We shall then know that "chance" has far less to do with our health, strength, worldly success, or misfortune, than our ignorance made us previously believe—that, in fact, there is a cause for every thing; and the cause of ills, for the most part, is in our own want of knowledge, untrained natural inclinations, or vicious propensities, causing us to disobey the just and holy laws of our blessed Creator.

24. But human wisdom will not prevent *all* evil or sickness. All the knowledge in the world could not restore a radically bad constitution to perfect health, or recover a soul already lost. God has appointed human means whereby these calamities may in a great measure be prevented. Can we neglect to use these means, and then impiously charge the Almighty with the ills we suffer from our not obeying his laws? Such conduct is equally reprehensible whether viewed by the light of reason or that of revelation.

LESSON III.

On Food, Eating, and the Teeth.

25. Man is the noblest of all God's creatures. Most of the good qualities found in the physical structure of other animals are combined in man. No other living being has, in so large a degree, the power of accommodating itself to all climates, seasons, and kinds of food, man's reasoning faculties aid him much in doing these things, but they could *not give* the *original fitness*, or adaptability. All animals subsist chiefly on food, and their natural health and strength depend, very much, on this food being supplied of a proper quality, and in due proportion.

26. Man has been placed, by his Creator, in a world very well adapted for supplying all his physical wants; and with powers of body and mind, peculiarly fitting him for procuring food to support his body. His teeth are of such form, order, and number, (twenty in the first, and thirty-two in the second or permanent set for life,) as to fit him for living on a greater variety of food, than other animals.

27. Food should be well chewed, or masticated. The more it is broken down, well pounded, and mixed with the saliva, which constantly issues from six glands or vessels in the interior of the mouth during eating, the less work there will be to do in the next process—digestion. Those who are robust and healthy, need not be so very particular in attending to this; but all persons of weak constitutions, feeble or disordered digestive powers, as well as those who pass an inactive life, especially if very studious, ought to attend most carefully to this rule.

28. For this reason we should take great care of our teeth, because they will be injured and lost by neglect; and we then could not masticate or chew our food so well, and should be obliged to leave more to be done by the gastric

juice in the stomach. Teeth are lost for want of care, and a few from defects in some families. When we finish a meal, it is impossible to avoid leaving some small particles of food in the mouth. Should any lodge between our teeth, that generally gives us a little uneasiness, and we endeavour to pick it out.

29. But the surfaces of the teeth, employed for grinding the food (five above and five below, on each side) are very uneven, that they may be the better suited for bruising it. Small particles of food are liable to remain in these irregular places, on the surface; or if the gums are not healthy, some will lodge between them and the teeth. In all cases, these trivial remains of a meal ought to be removed, as soon as convenience will permit, by washing the mouth.

30. In some European countries they even do this before company, but it does not look well. The teeth should be thoroughly cleaned with a good brush and water, every night before going to bed; as sleeping with unclean teeth both does them harm, and gives a bad taste in the mouth. A little tooth powder should be used occasionally, if the teeth will not keep white without, as foul teeth are so very offensive.

31. Every thing we use for food is subject to decay. If a meal, instead of being eaten, should be allowed to stand twenty-four hours in the way it is served up, all would be spoiled, more or less. But if the whole were mixed up, and well pounded together, as is done in eating, and then left to stand, the decay would be much quicker.

32. This is the way, on a small scale, with food, when left on the teeth; the spittle and the warmth of the mouth greatly promoting its decay. Many people have thousands of minute living animals constantly in their mouths! Some clean them out *occasionally*, but this allows much tartar, or hard matter to form, and encrust the teeth; the best plan is to do it *regularly* every night and morning.

33. When we know it to be a law of matter, that food, left in the mouth, will decay, and in time, if suffered to remain, may breed insects to eat through the hard enamel of some tooth or teeth; and that this will give us severe pain,

and cause the loss of those beautiful instruments given us by our benevolent Creator to minister to our comfort, health, and life; how careless, and even foolish it appears, to neglect such wise and good laws.

34. Many young people are extremely fond of sweets, rich pastry, and other articles, that give a pleasant taste to the palate. But mere taste gives no nourishment to the body, and we always find these children more feeble and sickly than others, whose appetite is not spoiled by such trash. Besides, these kinds of food adhere more to the teeth than many others, and are more difficult to remove; so that any one indulging in them must either bestow far more pains in cleaning their teeth, or suffer more in toothache, and loss of teeth. Remember, God gives us two sets of teeth; if we lose the second from neglecting our duties, we, alone, are to blame, and must bear the evil.

LESSON IV.

On Digestion.

35. When food is sufficiently masticated, we pass it over the top of the windpipe (which is then closely covered up, to prevent any entrance there) into a tube called the gullet, situated behind the windpipe; which, extending down the neck and breast, expands a little below the heart into a large bag, called the stomach.

36. This bag is to contain our food while it is gradually, but in health, effectually prepared for the various purposes for which it is required by nature, to renew and strengthen the physical body. This is called digestion. A full stomach resembles, in form, the bag of a Highland piper's instrument; when we are hungry it collapses, and shrinks up like an empty purse, or a bladder from which the air has been expelled.

37. In the annexed Fig. 1, it is shown as containing an

ordinary meal, and appears to form a mere enlargement of the gullet; which contracts again, at the right extremity, into a tube called the small intestines. The gullet, stomach, and intestines, consist of three membranous coats, forming a tubular pipe, in man, from thirty to thirty-six feet long; or about six times the height of the individual. These membranes are called the *serous* or outer coat, the *muscular* or middle, and the *mucous* or inner coats.

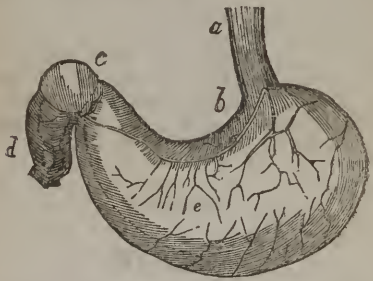


Fig. 1. A Full Stomach. *d*, Duodenum; *e*, Arteries.

38. In this representation of the stomach, *a* is the gullet; *b*, the *cardiac* or left opening, and the passage out of the stomach on the right, at *c*, is called the *pyloric*, porter-like, or guarded extremity; because of a small valve which is placed there, within the tube, to prevent any thing from passing out of the stomach, till it has been properly digested. When any undigested substance attempts to pass this valve, it shuts, and will not permit any improper thing to go out of the stomach and do harm to the system, without offering all the resistance in its power.

39. When food is eaten, and passed down the gullet into the stomach, a transparent fluid, called gastric juice, issues from numerous glands, situated in its inner or mucous coat. Here food would soon ferment, or become putrid, if this juice was not supplied for the purpose of digestion, and it flows rapidly from the time we begin to eat, till the stomach

is empty; gradually producing a great change, in all the food subjected to its influence.

40. The gastric juice mixes far more readily with liquids than solids, and, consequently, much liquid hinders the digestion of solid food, till the matter it may contain has been coagulated, and extracted from it; when the water is absorbed by the innumerable capillary vessels of the stomach, much in the way water is absorbed by a dry sponge. When a sponge is full, it can take up no more water; and so the absorbent powers of the stomach can only take up a certain quantity of water. If liquids continue to pour into it, they cannot be so readily taken up as before, but must remain, and prevent the gastric juice from becoming so fully infused into the solid food, as it otherwise would have been. Fluids may sometimes be heard shaking in the stomach like water in a bottle.

41. Pure water is immediately absorbed, while other liquids require the chemical action of the gastric juice, to set free the water they contain; so that all the matter of which they consist, except water, may be left in the stomach; when the matter thus left behind is then operated upon as though it had been eaten. Probably one reason why we swallow liquids before solids, when both happen to be in the mouth together, as in taking tea, is, that they may be the more readily absorbed, and the digestion of the solid food be thus less impeded, by their presence weakening the gastric juice.

42. Spirit, or alcohol, is contained in all drinks that will make man drunk; and as spirits are always employed for preserving organic matter from decay, their presence in the stomach must very much hinder digestion, by preserving the food from the action of the gastric juice. If drunk during eating, alcohol does most harm; as even water is better taken at the close, than in the course of a meal.

43. There is nothing in the whole economy of man's physical organization more wonderful than the process of digestion. With all his inventive subtlety, man will perhaps never discover how to prepare the food before it is digested, so as to fit it for passing through the stomach im-

mediately, to supply the many purposes for which nature wants it in the body. And even if he could accomplish this, the discovery would only be useful in sickness; for, in health, the stomach digests the eaten food it receives without a thought, or a voluntary effort on our part. Indeed, food cannot be prevented from digesting, if placed in an empty, healthy stomach, unless we take violent exercise, or drink much spirits.

44. Perhaps the best, at least the most generally understood chemical experiment, for clearly showing the process of digestion, is that of pouring a cup of water on a piece of quick lime, in a mortar or a basin of stone-ware. The lime immediately begins to absorb the water, and from being a solid hard stone is soon melted down into a soft pulpy substance; the lime and water forming a new kind of matter, for useful purposes which neither could have served of itself. So the gastric juice dissolves the masticated food into a soft pulpy greyish-coloured paste, and the two substances thus form a new combination of matter, called *chyme*.

45. A meal is thus gradually changed, and as soon as any portion of it is reduced to this state, it is ready for nature's use, and is immediately taken, and employed by this unerring architect, for numerous purposes. If too much food be taken at one meal, the gastric juice cannot flow so freely as it ought to do, from the vessels which supply it being partly stopped up and over-strained, by the pressure of too large a quantity of food.

46. If too little food be taken, and especially if the stomach remains empty too long, the gastric juice loses much of its digestive power, from not being drawn off in the usual manner; and nature is also enfeebled, for want of due nourishment. Hastily and imperfectly masticated food is far more difficult to digest than if it had been bruised and broken down by the teeth very well; as the gastric juice cannot get so easily to every particle. Even a suitable diet, without exhilaration, gives a gloomy, desponding tendency, instead of a cheerful buoyancy of spirits.

LESSON V.

Digestion Concluded.

47. When the body is feeble from any cause, and especially if the digestive powers partake much of that feebleness, rest, both of body and mind, is very needful immediately after eating; for though we are not often conscious of the fact, nature exercises a considerable amount of power, in supplying the gastric juice for digesting an ordinary meal.

48. If the whole of nature's powers are much below the usual amount, and we attempt to draw largely on her store for other purposes, when she has only strength enough for carrying on the process of digestion, we then do serious injury, and are sure to suffer for it sooner or later.

49. Even in perfect health, violent exertion immediately after eating is hurtful. To prove this fact, an eminent physician took two greyhounds, and gave them as much stiff paste, made of oatmeal, as they would eat. He then turned one dog into the parlour, took down his gun, went out with the other, and after three hours' severe coursing returned, and immediately killed and opened both dogs. The stomach of the one that had lain on the hearth-rug, before the parlour fire, was found to be empty, (though this would not have been the case, without previous exercise,) while that of the other still contained the food, eaten three hours before, like a solid lump of dough; the strength of the animal having been too much exerted in running, to permit the flow of the gastric juice for digestion.

50. Cheerful conversation, especially if it comes naturally from the gladness of the heart, and not from the exciting influence of mischievous drinks, is also found to promote digestion. Probably the gastric juice can get access more freely to every particle of food, from the peculiar motion of the stomach during a joyous laugh. Invalids may also promote digestion, by placing themselves in a reclining position

on the back; but care should be taken not to fall asleep, for some time after eating, as that impedes digestion.

51. Animal and farinaceous food digests in about one-half the time of vegetables, (though the mode of cooking food affects its digestion,) and a well masticated meal, much sooner than one that has not been broken down by the teeth sufficiently. The gastric juice has a great deal more power in some people than in others, and even in the same stomach, at different times. The skins of fruit, especially dried foreign fruit, are sometimes little altered by its action; while at other times, it appears completely to have dissolved them.—See secs. 217 to 231.

52. The moment a mother's milk enters the stomach of her babe, the milk begins to coagulate; and the gastric juice collects or extracts the nourishing substance from it, the water being absorbed by the capillary vessels. In after years, the result would be very different in the same individual. The gastric juice seems to have no influence on any thing possessed of life. It is sometimes found to dissolve or eat through the stomach, after death.

53. Much of the knowledge man possesses of the peculiar economy and operations of the stomach, has been acquired during the present century. Dr. Beaumont, of America, has contributed to this, perhaps more than any other individual; by the publication of the results of his numerous and long-continued experiments, on the stomach and gastric juice of a living man, who had (unfortunately for him) been shot in the stomach. The wound in the flesh did not, as is usual, close in healing; but the edges healed, leaving an aperture open into the stomach, through which any thing of a suitable size could be introduced or taken out. In sections 218 to 227, will be found a classification of about thirty different articles of diet, with the time each required for digestion during the above experiments, cooked in the various ways food is usually prepared.

54. The whole human race are under great obligations to this enterprising and benevolent man, who not only made these experiments, but, in the true spirit of Christianity, published them. Had not God put it into the mind

of this American, to make known to the world the results of his labours, we should have possessed far less knowledge of this vitally important part of the human body and of its functions than we do at present.

55. How wonderful and mysterious the ways of Providence appear, to short-sighted, ignorant, vain man! How often is the greatest amount of good done, by the most unlikely and humble human means; and how feeble a human effort God sometimes employs, for revealing the hidden workings of his great and unchanging laws! But when he has shot forth these rays of Divine light, how different are our duties, from those who could not get the knowledge he now gives so liberally to us! When a knowledge of physical or spiritual things is placed within our reach, we become responsible in a far higher degree than those who could not by human means get such knowledge. "For unto whomsoever much is given, of him shall be much required."

LESSON VI.

On making Digested Food into Blood.

56. Supposing food to have been well masticated, and properly fitted, by the action of healthy gastric juice in the stomach, to pass from it without any resistance, (through the opening which we have seen to be so well guarded by a door or valve that always attends strictly to its duty,) we now pursue the inquiry; for the purpose of seeing, what all this preparation was designed for.

57. After passing the watchful sentinel, the gentle stream of chyme enters the first portion of the small intestine or gut called the *duodenum;* and immediately arrives at a place in this tube where a vessel or duct from the liver and gall-bladder, drops the bile into it; and it also receives the pancreatic juice from the pancreas, at the same time. The

object of these two fluids, especially the bile, is to cause a separation of the most nourishing portion of the chyme suitable for making new blood, from the grosser matter.

58. The chyme still proceeds, but the newly introduced matter causes a rapid chemical action in it; and, on arriving (which it shortly does) at a second portion of the intestine, called the *jejunum*, the more vital part of the chyme finds the mouths of numerous, very minute vessels called *lacteals*, open, which take it up, as it is set free from the rest by the chemical action of the bile and pancreatic juice. Here we begin to see something of the great objects of nature.

59. The lacteals convey the vital fluid, now called *chyle*, (as they draw it gradually off from the intestines) along the *mesentary*, through the mesenteric glands; after which it enters the *receptacle of the chyle*, where it meets, and is joined with a fluid called *lymph;* brought, by the lymphatic vessels, *k k*, Fig. 2, from various parts of the body into the receptacle of the chyle.

60. The chyle and lymph, being formed into one fluid,

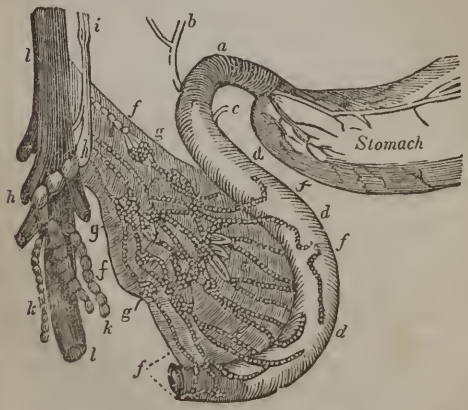


Fig. 2.—Making food into blood.

of a very light pink colour, pass up the receptacle of the chyle, into the *thoracic duct*, which is in man, a little thicker than the barrel of a crow-quill. The thoracic duct leads upwards, nearly by the side of the *aorta*, *l l*, or great artery of the body, till the chyle is poured from this duct into the left subclavian vein, under the left clavicle or collar bone. The chyle is urged on by a great force, in its passage to join the venous blood, as this blood passes back to the heart, after going its round of circulation.

61. No food or drink, received into the stomach, can really give nourishment, or add strength to the body, till it has gone through the natural process just described; and entered, in the above manner, into the vital circulation, which is truly called the "stream of life."

62. As it is important each part of this process should be clearly understood, the organs employed by nature in these operations are here represented in connection with each other, and apart from the other organs, by which they are surrounded in the human body. In this, and all the other figures, we look at the organs as being in a body with the face towards, and the back from us, and in an erect position, if not otherwise stated.

63. With Fig. 2 before us, we will again run over the operations, to fix them more firmly in the mind. The stomach is seen pouring its properly digested contents through the *pyloric valve*, *a*, at its right end, into the *duodenum*, the first portion of the intestines.

64. The ducts, from the liver, *b*, and *pancreas*, *c*, are seen distilling their necessary juices into the chyme; and the *jejunum*, *d d d*, with its numerous lacteals, *f f f*, ready to absorb the required nourishment, to convey it along the mesentery, *e e e*, change it materially in the knots of beads (as they appear) of the mesenteric glands, *g g g*, and to deposit the fluid thus changed, in the receptacle of the chyle, *h h*, whence it passes up the thoracic duct, *i*, and is poured into the venous blood.

65. This natural process, however, is very far from being alike in all persons. The ploughman has difficulty in finding food that will digest slow enough, while the dyspeptic

invalid can find few things that his feeble, diseased stomach can digest. The one cannot "stay" his stomach, while the digestive power of the other is almost dormant.

66. After the food is digested too, the proportion taken up for making blood, and supporting the body, is very far from being always equal. In the gluttonous gourmand, a very small quantity of the food eaten is thus absorbed; while, in the frugal living, and hard working labourer, a very large proportion is taken up by the lacteals, and converted into chyle for making blood. In cases of actual starvation, there is no doubt that nearly the whole of the small quantity of food eaten, is taken up by the lacteals and converted into nourishment for the body.

67. Both the over supply of food in the glutton, and the too scanty proportion of nourishment to support nature in the unfortunate owner of an empty stomach, are hurtful to health; the one painful and immediate, the other more remote, but not less sure. We cannot force nature beyond certain limits without injury to health and strength; and though the two last are not to be ensured to any one by food and drink alone, a due supply of these forms an important part of the necessary means for their attainment.

68. Little or no chemical difference can be detected in the chyle, whatever may be the quality or character of the food from which it has been extracted. Nature thus, apparently, converts the most rich and nourishing, and the most poor and coarse food, into the same kind of chyle. There is no doubt, that more bodily strength is extracted from the Irish hod-carrier's *penny dinner* of potatoes, than from the voluptuary's *guinea dinner* of rich, high-seasoned dishes.

69. After the required quantity of chyle has been taken up from the chyme by the lacteals, (see sec. 58,) the remaining portion not wanted for any purpose by nature, continues to pass along the intestines, propelled by the *peristaltic* or worm-like motion of their coats, and is finally ejected from the body. See in Fig. 29, sec. 288, and Fig. 30, sec. 295, the form and natural position of the bowels, stomach, &c.

70. How beauteous and wise are the laws that regulate and govern the action of all within us! The valve, so sensitive—the juice and bile, so powerfully dissolving—the minute vessels, so nice and discriminating as to take up *only* the matter fittest to be converted into blood—and the certainty with which the liquids go on in the right course, through all the intricate windings of ten thousand tubes, without any visible agency! Who can help exclaiming, there is a God! who made and upholds all these things? How anxious ought we to be, to get some knowledge of them, and of the laws by which they are governed! Without such knowledge, our feelings flow from mere instinct, and our gratitude to the Giver of all these blessings can be little, if any higher, than those of the unlettered savage. Should this be so?

LESSON VII.

On the Blood.

71. We need not stop to speak of the appearance blood presents, when taken from an animal, that being so well known; but will endeavour to show what it is composed of, with the means by which, and the purposes to which, nature applies it in the human frame.

72. It may be said, "we have already seen that the blood is formed out of the food." True, but in this, as in many other of nature's works, we have a substance quite unlike that from which she, by the mysterious action of her laws, produced it. The blood she makes out of milk, is found to have iron in it!

73. We are told by chemists, that healthy blood contains no less than twenty-six different kinds of matter or substances; and if so, a singular agreement exists between the number of ingredients (26) employed by nature to build up, and continue the human frame in health for a time;

and the number of characters (26) we use in our language, for conveying our thoughts, feelings, and opinions, to each other and to society.

74. When we have seen the great number of purposes to which nature applies the blood, we shall cease to be surprised at finding so many substances in it. Nearly four-fifths of the blood consists of water. We need not detain ourselves by describing any but the chief of the other substances, such as

75. The clot, *Crassamentum*, or solid dark-red mass, formed when blood newly drawn from the living body cools; and the *Serum*, a greenish whey-like fluid in which the clot, after being sometime cold, seems to float. The clot contains *Fibrine* (from which the skin, vessels, muscles, &c., are made); also *Hæmatine*, iron, and many other substances. The serum consists of water, *Albumen*, and similar kinds of matter.

76. When circulating in the body, a large proportion of the clot was liquid, and mixed with the serum. On examining blood closely with a microscope, it is observed to be full of very minute red *Globules*, which float in the liquid fibrine and serum, and give the red colour to the whole mass.

77. These globules are in form like flattened peas, and in man's blood are found to be from the 4100th to the 2600th part of an inch in diameter. Small as these are, science has hit on a way of making them smaller, by washing the outer envelope of red colouring matter (hæmatine) away from a white grain forming the centre of the red globule, and about one-fourth its size, which consists of matter slightly differing from fibrine and albumen in its nature and properties.

78. The best chemists give the proportion of each kind of matter in good healthy human blood as follows:—In every 1000 equal parts, 786½ are water; 119⅔ colouring matter, or hæmatine; 69½ albumen; 3⅔ fibrine; 4⅕ crystallizable fatty matter; 2⅕ oily matter; 2 extractive matter, soluble in alcohol and water; 2 albumen, combined with soda; 7⅕ chlorurct of sodium and potassium, alkaline phos-

phate, sulphate and subcarbonate; $1\frac{1}{3}$ subcarbonate of lime and magnesia, phosphates of lime, magnesia and iron, peroxide of iron; and $1\frac{1}{3}$ of other substances not named by chemists.

79. Each kind of matter in the blood is no doubt, in health, required by nature for some useful purpose. Look, for a moment, at the difference between bone and flesh—muscle (lean flesh) and fat—tendon (gristle) and nerve—nails and hair—all made from, and fed and nourished by the blood; and the necessity of nature having many different sorts of matter in this, her great fountain, will be self-evident.

80. We shall see, also, how the health is affected by each of these substances not being contained in the blood, in natural proportions, or nearly so. If our food, drink, and air, are not such as to furnish nature with the means of getting all she wants, some parts become deficient in time, and the health must suffer. A great variety of food is, however, not necessary—the quantity and quality are most important. Take enough, but no more.—See sec. 231 to 244.

81. If we attempt to force on nature too much of any or all the kinds of matter she requires, or any ingredient she does not want, her efforts in building up the frame are weakened, by being called off to *drive* out of the system those things that would do harm there. The same thing happens when we do not help her to get rid of all waste matter from the body by proper exercise, keeping the skin all clean, &c.

82. The particles of matter used by nature being so extremely small, (some of them many hundred times less than a grain of sand,) she is able to carry on this work by very slow degrees; so that if we do not break her laws and disturb her very often, or long at once, we feel all to be going on well.

83. If such were not the case, our slightest errors would cause us much suffering; and if continued, might soon prove fatal! How nicely we see every thing within us planned and kept in order for our comfort and happiness.

Can we still continue to disobey the Creator of such good, wise, and merciful laws, now we know a little of them? Or be unkind to those who take so much trouble in trying to teach us all they can about them!

LESSON VIII.

On the Heart, Arteries, and Veins.

84. The spring from which the blood flows is the heart. We have seen it is not made there, but enters the heart by two doors, and is sent from it by another door continually during life. The channels or tubes, in which the blood goes from the heart, are called *Arteries;* those by which it returns are called *Veins;* and this constant flowing of the blood to and from the heart is called the *circulation of the blood.*

85. The form, colour, and strong muscular coat of the heart are well known, from those of the sheep, cow, &c., being so often seen hanging up in the market; but we require it before us, to give a clear idea of its parts and offices, for the heart is not a solid body. It contains four separate and distinct cavities, cells, or chambers, and no less than eleven doors, or valves, leading to and from them!

86. Having this important organ before us then in Fig. 3, we proceed to point out *a*, as the descending, and A, as the ascending vein, by which the blood, from all parts of the body, enters the uppermost right cavity, or right *auricle* of the heart, *b;* a valve being at the mouth of each vein, so formed as to admit blood freely into the heart, but prevent its going out the same way again.

87. A strong muscular partition or wall forms the inner boundary of the right auricle, and contains a valve or door, by which the blood passes into the second cavity, called the right ventricle, *c.* The heart sends the blood out of the right ventricle into the lungs by a valve, or rather set of

valves, through the large pulmonary artery, *d*, and its smaller branches, *d d d*, running into all parts of the lungs.

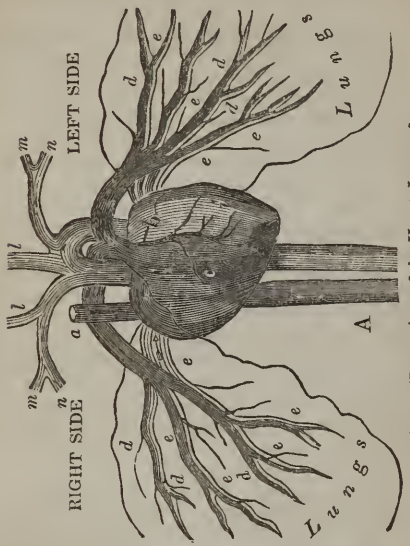


Fig. 3.—Front view of the Heart, Lungs, &c.

88. The blood having done its offices in the lungs, (for which see sections 102 and 103, and Lesson XII.) returns to the heart again by another series of tubes, *e e e*, the pulmonary veins; which join to the heart by four branches, each having a valve to admit the blood into a cavity on the left side of the heart, called the left auricle, *h*.

89. The fourth cavity, *i*, is separated from that last named, *h*, by a much thicker and stronger wall than that separating the first cavity, *b*, and the second, *c;* and a valve in this wall admits the blood from the left auricle into this, called the left ventricle, *i*. The blood is then sent, by the

powerful action of this, the strongest part of the heart, through the *aorta*, *k*, and its branches to every part of the body.

90. The heart is more necessary for life, and is less under the control of the will than any other organ of the body. It is seldom diseased, and is so strongly guarded by the bones forming the chest, (where it is situated a little to the left,) that it suffers less from accidents than most of the other organs. All the valves belonging to the heart are formed in such a peculiar manner, that while they freely open, and admit the blood to flow the *right* way, they will not let it return. These things will be all better understood after reading sections 98 to 116. The natural situation of the heart and lungs is seen in Fig. 30, Sec. 295.

91. The aorta, and all its branches, are called *Arteries*, because they were supposed by the ancients to carry air; being always found empty after death. They are all tubes, formed of three coats; the inner one is least elastic, and is the first to break if an accident unfortunately happens to pull a limb off, when, by curling up, it draws the whole end of the broken artery inwards, so as to form a plug, by which the blood is hindered from flowing; and life is thus saved, in many cases.

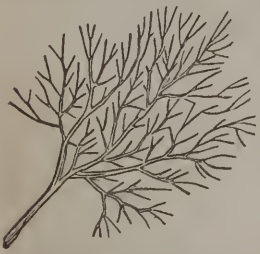


Fig. 4. Branch of an Artery. Fig. 5. Branch of a Vein.

92. The arteries being very important vessels, and accidents to them often of great consequence, they are as little exposed on the surface of the body as possible, and

go in the most direct course they can, to the various limbs and organs of the system. See in Fig. 4, how straight the artery is, as compared with the branch of a vein in Fig. 5.

93. The arteries spring from the left ventricle of the heart, as seen in Fig. 3; the first or great artery, the aorta, *k*, passing upwards some distance; and then curving into a fine arch, at the same time sending off the carotid arteries, *l l*, to the head, the subclavian arteries, *m m*, to the arms, the vertebral arteries, *n n*, to the spine, &c., it turns down the chest; passes through the diaphragm, down near the spine, and divides into two equal branches at its lower end, one going to each of the dependent limbs.

94. Along the whole course of the main artery, and of all its branches, small arteries are sent off, to supply blood to all the surrounding parts; be they organs, limbs, muscles, bones, nerves, skin, or any other substance requiring it. As the arteries extend from the heart to all parts of the body, they grow continually smaller and smaller, like the branches and small twigs of a tree; till they become lost to the eye in another class of vessels, called capillaries, for which see section 109.

95. The blood, having done its office in the capillary or hair-like network, is seen entering the *Veins*, a large class of vessels that take the blood back to the heart from every part of the whole body; beginning in almost unseen twigs, which are found continually growing thicker, and becoming united into larger trunks, till they all terminate in the two great veins; *a*, the descending, and A, the ascending vena cava, in Fig. 3, which bring the blood back to the heart.

96. The tubes forming the veins consist of three coats, similar to, only not so elastic as, those forming the arteries; but the veins are much more crooked, as may be seen by comparing Fig. 4, a branch of an artery, and Fig. 5, a branch of a vein; and in many veins, especially those in the lower limbs, there are valves so formed as to permit the blood to flow freely towards the heart; but, if any effort of the body tends to check this current, or throw the blood back again, these valves immediately shut, and it is still urged on in its course towards the heart.

97. Generally, in every part of the body, a vein runs near the course of each artery, about the same size, one bringing blood from, and the other taking it back to the heart; but there is a remarkable difference in the colour of the blood they contain; that in all the arteries, except the lungs, being of a bright red, while that in the veins, except those of the lungs, is of a deep dark red colour. In the lungs, arterial blood is darkest. The great importance of these things will be seen in the two following Lessons.

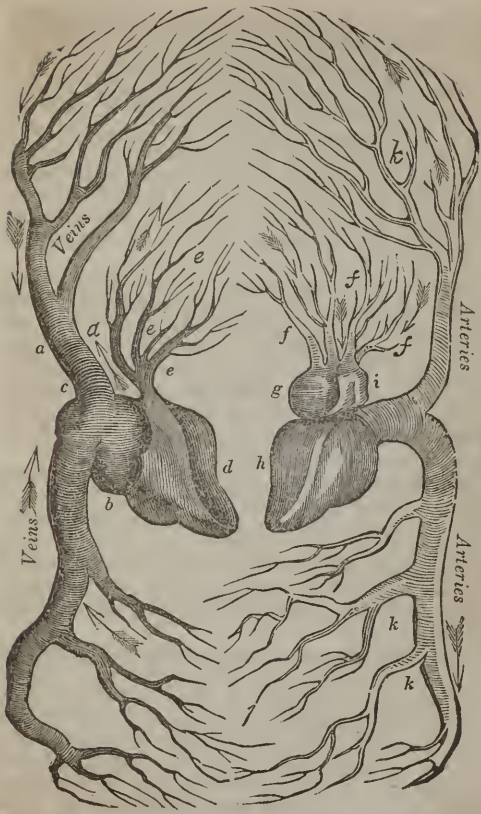
LESSON IX.

On the Circulation of the Blood.

98. The way in which the blood is made—the many kinds of matter it contains—the organs from which, and the vessels by which it moves to and from all parts of the body, being well understood; we are now far better prepared to consider and form clear ideas of its motion, called the circulation of the blood; and the vital importance of this to our health and strength.

99. We will begin with the circulation, at the point we concluded the making of the blood, in section 60, which should now be read again. We there saw the chyle from the thoracic duct, poured into the venous blood on its way back to the heart to be purified, and made fit to feed the various parts of the body with healthy matter, to sustain life.

100. To make the course of the blood more clear through the whole process of its circulation, we will make use of a plan which, though it is much different from the real course pursued by nature, will give a very good idea of that course; and by the manner we use it, will not lead into any error, as to the blood's natural course. This plan will be seen in Fig. 6, where the heart appears divided into two, and the veins are much darker, and more crooked than the arteries; except in the lungs, where the case is reversed.



101. We begin then with the two great veins, *a*, the ascending, and *b*, the descending vena cava, which bring

the impure and the new blood, and pour it through their valves, into the right auricle of the heart, *c*; from which it immediately passes into *d*, the right ventricle, through a valve so constructed as to admit it to flow freely, but prevent its return the same way into the auricle, *c*, again.

102. Every time the right ventricle, *d*, is thus filled with blood, it exerts its strong muscular power of contracting, and sends its contents through three valves upwards, into the main pulmonary artery, *e*; and the blood passes by the innumerable branches of this artery, *e e e*, into every part of the lungs to be purified, and have its vital properties renewed.

103. These branches terminate in fine hair-like vessels, (*pulmonary capillaries,*) by which the blood is exposed to the action of the air in the air-cells of the lungs; and through the coats of these cells, about one thousandth part of an inch in thickness, its impure particles (carbon, &c.) pass into the air; and the life-giving properties of the air (oxygen, &c., see secs. 121 and 123) are received by the blood; which is instantly changed by these chemical processes, from being of a deep dark red to a scarlet colour.

104. The blood being, in this wonderful manner, purified and made fit for being again sent through the system, is seen to be received from the pulmonary capillaries, by the fine twigs of the *pulmonary veins*, *f f f*; which gradually become joined together, in their progress towards the heart, till they unite into four main trunks, that pour the renewed blood into the left auricle of the heart, *g*, through their valve-protected mouths.

105. The presence of the life-giving fluid in the heart stimulates it to immediate action, and the blood rushes through a valve, so situated in the wall dividing the left auricle, *g*, from the left ventricle, *h*, as to admit the current to pass freely that way, but completely to stop its return.

106. Every time the left ventricle, *h*, is filled with blood, it instantly contracts; the lower point of the heart is suddenly tilted forward, with some force, against the ribs of the left side; and a tidal gush of blood is sent out of the ventricle, *h*, into the aorta or main artery, *i*, through its

valve-protected mouth. This ventricle, *h*, having to send the blood through the arteries, *k k k*, to every part of the body, is much stronger than the other parts of the heart, that it may be the better able to overcome any thing hindering its circulation, even in the most remote members.

LESSON X.

Circulation of the Blood, concluded.

107. Each tidal gush of blood urges on that which is already in the arteries, under the combined influence of the force given by the heart—the elasticity of the coats of the arteries—and, very likely, those parts of the body wanting nourishment also draw it along, by their absorbing or sucking powers, for the arteries are found empty after death. We feel the sudden impulse of the heart, almost instantly, in every artery; that at the wrist, commonly called "the pulse," is best known, being generally used by medical men to try the state of the circulation. It beats, in health, from 60 to 75 times a minute.

108. By each successive impulse of the heart, impure blood is also sent from the right ventricle, *d*, through the pulmonary arteries, *e e e;* to discharge its foul matter into the air vesicles of the lungs, and be expired from the mouth. All the valves in the heart are so formed, that while they freely admit the blood to pass the way it ought to go, they will not let it return again the same way; and they are always performing these active and passive duties, of opening *right*, and *not* opening *wrong*, through the whole course of our lives—sleeping or waking—without our having to bestow the least care or thought on the matter.

109. All the arteries end in very fine hair-like capillary vessels, which form a minute network in every part of the whole body, for giving the vital properties of the blood universally through the system; each receiving the peculiar

particle or particles wanted, for its support and nourishment. Read again, carefully, sections 73 to 83, giving an account of the composition of the blood, which is the only fountain from which nature draws all her supplies, for nourishing the whole physical structure, and continuing life.

110. Our bodies have been entirely formed, are now forming, and will continue to be thus built up during life, from the blood, while in this network of minute vessels; each pulsation sending another, and another grain (if so large a term may be given to these fine particles) of matter, to every point in the whole system that wants one; and to each part such kind only as it requires for health and strength. The whole body is so entirely renewed in this way, during every six or seven years, that it is said no particle of the old matter remains even in the bones, beyond this period!

111. But besides this work of building up the body, another equally important office is performed by the blood in the capillary vessels; for all those particles of matter that have at any time been long enough in the body, and which are no longer wanted there, become loose, so to speak, and are received into the blood, and thus carried away out of the system. Sudden emotions of the mind, also, affect these vessels much, of which we have a familiar example in the blush shame sends into the face by them.

112. The blood having done these important duties, in much less time than it takes to describe them, is pushed on, by another pulsation of the tidal stream coming to do the same offices; and is seen entering the twig-like ends of the veins, that join to the capillaries, from which it is flowing. But a striking change has taken place in its colour. From being of a bright, it is now of a very dark red hue, and is no longer fit for the natural purposes of life.

113. The veins, at first like very fine threads, are continually growing thicker, and becoming united together; the dark blood goes along them in a steady, constant stream, till it finally enters the heart again, through the ascending or the descending vena cava, to be returned to the lungs

for purification, as shown before. We have thus seen the venous and the new blood enter the heart—go thence into the lungs to be purified—return again to the heart—be sent throughout every part of the system, by the arteries, into the capillaries—there to build up and keep strong the whole human frame—and then return, in an impure state, through the veins to the heart.

114. This appears much like the watering and draining of a great city. A main pipe brings the water from the common reservoir, and wherever water is wanted, a small pipe, of proper size for the supply, branches out, and terminates in a tap or taps, from which the water is drawn as it is required for use, like the blood from the capillary arteries. We next find the refuse water, after aiding in the various purposes of life, entering small channels; and overloaded with all kinds of impurities, making its way to large sewers or main drains, from which it is ultimately poured into the common receiver.

115. When we reflect for a moment that during each day of our past life, 100,000 pulsations of vital healthful blood have been sent out from the heart, and again received into that active organ—and that the quantity thus daily passing through it in an ordinary-sized body is about 13,000 pounds—what feelings expand the mind! "wonder, love, and praise," strive by turns to fill it!!

116. And these feelings are increased, in every devout mind, on finding that the advantages which flow from a knowledge of the important laws contained in these two Lessons, were unknown to man, till they were revealed by science in the seventeenth century, to Dr. William Harvey; who first publicly taught his discovery of the circulation of the blood, in 1616, but was long only laughed at for his pains! How grateful should we always feel for this, and all the other blessings we enjoy, beyond those conferred on our forefathers! How much deeper our obligations, and heavier our responsibilities must be, than theirs! What return do we make for these blessings to Him who gives them? Do we love Him more, or obey and serve Him better, than our forefathers?

LESSON XI.

On Respiration, or Breathing.

117. This is one of the most constant and evident signs of life; to draw in (*inspire*) and to breathe out (*expire*) air, is to live. And yet, how very few people know what is really done, by every breath they draw! Indeed, are there not still many who think their breath is only for them to talk with, and to blow their fingers warm when they are too cold, or their food cooler when it is too hot!

118. Before we can clearly understand the important effects produced by respiration in the living body, we must first get to know all we can about the vessels and organs, and the air, employed by nature in this grand work. The breath, we know, is drawn through the mouth or nose, and goes down the windpipe, (*trachea*,) a tube composed of gristle, almost as firm as bone. It passes down in front of the gullet, (by which our food enters the stomach,) and is commonly called the throat, forming the front part of the neck; see *b*, Fig. 30, sec. 295.

119. At the lower end of the windpipe are situated the lungs, the chief organ of respiration. They consist of two great lobes, each fed with air by a main trunk of the windpipe, which sends off innumerable branches to every part of the lobe it supplies with air, the small twig-like ends of these branches ending in very minute air-bags or cells, in both lobes.

120. To give a better idea of this, Fig. 7 shows the two lobes of the lungs; *a*, being in its natural state, when filled with air, while the other lobe, *b*, has all the arteries, veins, and other matter taken away, leaving only the air-tubes (*bronchi*) which are dissected. The air-cells (being from the fiftieth to the hundredth part of an inch in diameter) are much too small to be shown in the engraving. The

natural position of the lungs is seen at *r* and *l*, Fig. 30, sec. 295.

121. The air used in breathing we take (*inhale*) from nature's common reservoir, the atmosphere, which surrounds the globe on which we live, to the height of about fifty miles on every side. It is not seen, but is felt; and is a fluid substance of vital importance to animal and vegetable life, made up chiefly of one kind of matter called *Oxygen gas*, and another called *Nitrogen gas*, or *Azote*, with a little *Carbonic acid gas*.

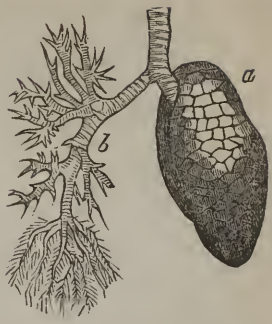


Fig. 7.—The Lungs.

122. Many other substances are often found in air, as it receives all the vapour which arises from land or water. Air is thus charged with good matter from the odour of plants and vegetables, and with the noxious vapour constantly arising from marshes, stagnant pools, filth, or any kind of decaying substance; and after passing over large sandy deserts, it contains too little moisture for healthy respiration.

123. But generally, these substances form so small a portion of the air we breathe, that it may usually be said to consist of the three *Gases* named; every 100 parts of air containing about 79 parts of nitrogen, 20 of oxygen, and 1 of carbonic acid gas. The air, in close or hot rooms, is often very differently composed; the seare the kinds of matter in out-door country air. The same quantity of air also fills a larger space in hot than in cold weather; as heat expands, and cold compresses it.

124. Air is found to be very different after it has been breathed, to what it was before. A considerable portion of the oxygen has been lost from the air we expire or breathe

out, and an equal quantity of carbonic acid added to it while in the lungs. There is also much more watery vapour in it than before inspiration. In cases of disease, nature relieves herself of much offensive and sometimes contagious matter by expiration from the lungs; and to inhale this again must be injurious.

125. A very simple and easily tried experiment will prove expired air has been much altered in the lungs. Take a glass of clear lime water and blow common unbreathed air into it with a pair of bellows or any other means, and you will find no change in its appearance; but immediately on blowing *your breath* through a tube into it, the water becomes turbid or muddy-looking, from the carbonic acid in your breath forming carbonate of lime out of the lime previously held in solution by the water.

126. The nitrogen remains almost unchanged in air by respiration being unfit to sustain animal life; so that when air is breathed over and over again, till all the oxygen is exhausted from it, death must immediately take place, for carbonic acid is a fatal poison when breathed. It is therefore certain, that breathed air has lost a large part of its vital, life-giving properties, and gained an equal portion of poisonous matter; and if repeatedly breathed, soon ceases to sustain life.

127. We usually take in about as much air at each breath as would fill a pint measure; and from 3000 to 4000 gallons pass in and out of an ordinary-sized, healthy person's lungs, every twenty-four hours. In sighing, we inhale two or three times as much air at once, as usual; because something has just engaged our attention so fully as to make us forget to breathe for a short time. Knowing thus much about the nature of the lungs, and the air we breathe—the vitally important office of respiration, with its influence on life and health, will now be understood much more easily than it otherwise could have been. The proper understanding of this is of immense importance.

LESSON XII.

Respiration, continued.

128. Each breath of air we inspire passes immediately into the air-cells in every part of the lungs, (if not obstructed by any thing,) which air-cells are from the fiftieth to the one-hundreth part of an inch in diameter; and all the outside of the very thin skin or membrane, of which they are formed, is covered with the fine threads of the wonderful net-work of capillary vessels, containing venous blood, sent there by the heart to be purified.

129. Instantly the air enters these cells, its oxygen is sent through their membraneous coat; it then receives the carbon from the venous blood, and a great change is thus produced in the vital fluid; a change as great but just the reverse of that which takes place in the capillaries connecting the arterial and the venous system, in every part of the body except the lungs. In the body, the blood changes from a bright red to a deep purple; but in the lungs, the air turns it into a bright red colour again.

130. When the blood has been thus purified (oxygenated) it returns to the heart; the air, now overloaded with carbonic acid, and deficient in oxygen, is expired; and fresh streams of blood and air are thus continually passing to and from the lungs, from birth to death. Read again, carefully, sections 101 to 113, about arterial becoming venous, and venous arterial blood.

131. The carbonic acid, thus constantly discharged into the air in populous towns, would become very injurious to health, and even life, were it not for the equally constant operation of two other most mereiful and wise laws of our great and good Creator; who has, and does, and will ever continue to do all things well.

132. He made it a law of vegetable as well as of ani-

mal life, to take in and send out (breathe, so to speak) air; but from the air *they* absorb or inspire, they consume carbon, and discharge or set free oxygen, so that the air is thus made more fit for being breathed by animals. And to increase the application of this blessed law, He causes currents of air (winds) even to carry this air, thus purified, to man and other animals, that they may live in health and comfort. How awful it is to think, that the breath thus wisely given, should sometimes be used to profane the holy name of Him that gives it.

133. Another important law in respiration is, that in man and other animals, exactly the same quantity of carbonic acid is discharged into the air in breathing, as the quantity of oxygen taken out of it; and when the carbon is consumed by vegetables, just an equal quantity of oxygen is again set free. Thus, the vegetable and animal kingdom mutually purify the air for each other, neither being capable of existing alone for any length of time; and both are generally found most healthy, in situations where they are most equally distributed.

134. How delightful, thus to see these laws working together for so much good to man. He breathes into the air, that which has done its duty in *his* body; this matter is then taken out of the air by grass, plants, trees, &c., for *their* nourishment and growth; while at the same time, they replenish the air with substances necessary for the health and life of man; and winds blow in all directions for the general diffusion of these kinds of matter, carrying oxygen for animals, and carbon for vegetables, wherever animals or vegetables are to be found!

135. The quantity of oxygen we consume in a given time, is far from being always the same. A citizen, who had been six months pent up in a densely-populated city, would take up four or five times as much oxygen into his system, during a good day's walk or ride in the country, as he would have done quite at home. In cold weather we use much more oxygen than in warm—during digestion, than when the stomach is empty—and, if violent exercise has been taken for some time before eating, about

four times the usual quantity will be consumed, while the food is being digested.

136. All these laws and facts clearly prove, that however nourishing and suitable the food we take may be, or however well it may be digested and formed into new blood, it cannot be applied for the support and building up of our bodies, till it has been fully prepared for that vitally important office, in the lungs. This can only be *well* done by breathing a tolerably pure atmosphere, and admitting it freely into the respiratory organs; which ought, on no account, to be obstructed in their natural action.

137. We ought to lose no opportunity of enjoying the fresh air. If business, or other duties of life keep us much in-doors, we should omit no means our situation will allow, of having a current of fresh air, greater or lesser, according to weather and other circumstances, flowing gently through the room or rooms we may occupy: all sleeping apartments ought to be thoroughly aired, all day if possible. We require a plentiful supply of air during sleep, which we cannot have in close rooms or closed-up beds.

138. We should avoid, as much as we can, being in a very crowded room; or living in any low, damp, or marshy situation, or narrow, ill-paved, and ill-drained street, especially if there is not a free stream of air through it; and every thing ought to be removed from about our home, that may tend to render the air very foul. In all cases, where any of these causes prevent a good supply of pure air, no day should be allowed to pass, without one or more good walks, to get the purest air within reach, and as much of it as circumstances will possibly admit.

139. These are some of the best means for preserving health and strength, or even for regaining them when lost. In some large towns, twice as many deaths take place annually among those people inhabiting the most unhealthy districts, as occur in the most healthy districts of the same town, in an equal number of inhabitants. There is also a great difference in the healthful tendency of employments; such as admit the use of fresh air, and give equal exercise to all the limbs, are much the best. In selecting amuse-

ments for recreation, those should be preferred, that bring into full play such physical powers or mental faculties as are least exercised in our usual engagements, and allow the exhausted parts most complete repose. No tradesman who exercises a sedentary trade should neglect the observance of this principle.

LESSON XIII.

Respiration, continued.

140. Our efforts to get pure air are of little avail, unless we admit it freely into the lungs. As it is, unfortunately, very fashionable to prevent this, we must try to make the matter quite plain; and then leave every one to "choose whom they will serve" and obey—the ever-changing god of fashion, or the great, and good, and merciful Creator and preserver of all things; who ever was, still is, and ever will be the same, and whose laws neither slumber nor change!

141. The lungs are almost entirely formed of air-cells and blood-vessels; so that when we take in a breath of air, it is sent in nearly equal proportions throughout the whole organ, in such a way as to get in contact with the greatest possible quantity of blood. These air-cells are so numerous, that their surface or the membrane of which they are formed, is generally said to be about twenty times the extent of the whole surface of the body they are intended to supply with vital air!

142. To obtain a more clear and practical idea of the lungs, their form, structure and office—buy those of a sheep, or calf, commonly called "lights," with the heart attached to them. If you can get them warm from the animal, it is best; but if not, place them in warm water about ten minutes, till they are wholly warmed and become supple. They generally appear of a rather bluish and pink colour, very slippery to the touch, and the heart is suspended between

the two great divisions, by the veins and arteries which conveyed the blood to and from the lungs during the animal's life.

143. Having made the lungs about the natural heat, place a tin or other tube in the windpipe, (the gristly tube by which they hang,) tying it tightly with a cord, to prevent the escape of air. Blow a strong breath of air through the tube, and you will see the whole mass of lungs gradually filled with air; and (if they were very blue) you will see them at the same time change to a bright red.

144. On taking your mouth from the tube, you will see the lungs slowly reduce in size as the air goes out; and by thus frequently inflating them with air, and allowing them to collapse, you may see the natural action of the lungs in the living body. If the butcher has cut or pierced the lungs anywhere (which is often the case) you will hear the air escaping through the puncture, and if you cut them in any part, you may see the air tubes, and the air-cells too if you use a small microscope.

145. Now tie a ribbon, or piece of tape, round the lungs and heart, rather loosely; and, on again filling them with air, you will see the air cannot get into that part of the lungs pressed by the bandage, though above and below it they swell out as before. However hard you blow, a large proportion (perhaps one-fourth) of the air-cells cannot receive air while thus bound up, "to make them look pretty," as some would say. Even if you press your finger against any part of the lungs while you inflate them, you will see that very many air-cells are not filled with air; which is the case when you press your chest against the edge of a desk or table.

146. If you now look at Fig. 9, you will see the human chest in the form it was *made* by our all-wise Creator, to contain the heart and lungs. It is a strong bony framework, formed by the ribs and the breast and back bones, considerably wider at the bottom than the top; though when it is clothed with flesh, the shoulders make the chest appear widest at the top. You may see the natural position of the heart, lungs, &c., in the chest, in Fig. 30, sec. 295.

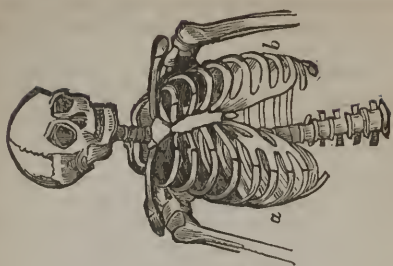


Fig. 9. Natural Waist, *a b*.

Fig. 8. Deformed Waist, *a b*.

147. We cannot, for a moment, think of charging the Divine architect with forming the chest of some people too large for their heart and lungs, or of an improper shape; but if we compare the lower part of the chest in Fig. 8, with that in Fig. 9, we shall see that the lady whose bust it represents, must have strangely altered her chest, for some reason or another. Every one who really knows what vital organs the chest contains, will shudder when they look at this, or any waist so unnatural, especially in a living body.

148. Measure the space between the points *a* and *b*, in both figures, and think of the fearful crushing of the lower ribs together, and squeezing up of the heart and lungs, that must take place, before the body could be reduced to so hideous a shape! How could air enter into the minute cells of the lungs? Indeed, how can life continue, when one of its most vital functions is so perversely cramped! Is not ours, truly, a long suffering and a merciful God, to spare the lives of such heinous transgressors? See! how the bosom and shoulders heave above the stays! yea, even the very neck swells, every constrained respiration! Monstrous!!

149. But we must try to speak of this sin calmly, for sin it undoubtedly is, wilfully to destroy health, strength, or shorten life. If the foolish practice of tight lacing is begun in early life, the lungs will, of necessity, be much smaller than they would have been had the physical laws of our nature been obeyed; nor is it possible for the body to attain the size and strength it would have otherwise done. The ill effects would be much more serious, and in most cases soon prove fatal, but for the temporary release cramped nature receives during sleep, as the chest is then generally left unbound.

150. Sometimes the chest is naturally narrow, and the waist small. Those persons we must pity, as we do other defects and painful deformities; but whether small lungs are natural, or caused by this baneful practice, the effects are nearly the same. It is utterly impossible for a proper sized physical structure to be kept in health and strength in all its parts, by a small pair of lungs; or if they be of due size, and are tied up during fourteen or sixteen hours in every twenty-four, to conform with fashions made by people who know so little about the organs of respiration, as to make room for the lungs *outside* the spine!

151. Those who are laced tight, find much difficulty in doing any thing that requires more than ordinary effort. Jumping, running up stairs, or a fit of laughing or coughing, produces evident distress in breathing; because, air and blood being admitted in such slow streams into the

lungs, any sudden effort requiring an increased quantity, chokes up the vessels, and produces a sudden check in the whole system. Even a strong horse cannot kick or make any great effort, if a trace-chain be tied round its chest; because of the pain produced by drawing in sufficient breath for the purpose. How then can a weak, frail creature do any thing, without breath to do it with? It is physically impossible to do this, and at the same time preserve good health.

152. This pernicious fashion is the chief cause of the frequent faintings we see in persons constitutionally weak, or where the strength has given way under the destructive practice. If such parties go into a crowded room, they are almost sure to have a fit; because the air having been breathed there so often, the small quantity they can inhale at once, does not possess sufficient oxygen for them. The state of the air in any crowded room may be easily tested, by placing a glass of clear lime water in it. If it be very foul, the lime water will soon become muddy looking, from the cause named in sec. 125.

153. Those cells and blood-vessels of the lungs that are cramped up, and prevented from performing their natural offices by this sinful custom, necessarily become inflamed; and, being soon irritated, produce coughing. The lungs thus often become diseased, when consumptive symptoms are not long in making their appearance, and the whole frame gradually sinks under the baneful torturings, originating in such wilful disobedience of the physical laws on which health and long life depend.

154. What strange infatuation! Should not death in these cases, as in those from intoxicating drink, be called slow suicide? Read again sec. 140; and then say, "whom you will serve" and obey—*Him*, whose "yoke is easy," whose laws are just and true, and whose reward is ever sure—or a vain fleeting shadow! Did not thousands prefer the latter, it would be impious to draw such a comparison. They who wilfully violate the laws of their physical constitution, shorten their own lives and violate the command which says, "Thou shalt not kill."

LESSON XIV.

Summary of former, and preparation for the future Lessons.

155. It appears desirable we should pause here a little, and, in a short Lesson, take a review of the progress we have made, the facts we have acquired, and the good we have derived, from the foregoing thirteen Lessons; and also, prepare our way for the future and far more important ones.

156. We have seen that the simple, the unerring, and yet mysteriously operating laws of God, pervade and regulate all things; from the smallest atom, to the most ponderous globe. All was created, and is still sustained, by and for Him; and no one has a right to say, "What doest thou?"

157. It is by his will and his laws, that our bodies grow, and are nourished by the food and drink we take, and the air we breathe; and kept warm by the clothing we put on them, and the houses in which we dwell. It is He who orders every beating pulse we tell, and every fleeting breath we draw.

158. And should we, in our puny strength and vain reasoning, say, "We will not have these things as thou hast made them; but will alter this, mend that, and entirely change the course of the other, of thy laws, for we know better what will make us wise and good, comfortable and happy, than thou doest?" Who can say some of their actions do not, in reality, speak such language as this?

159. Try now, how many of the leading facts learned from these Lessons, you can repeat in your own words, however simple those words may be. How far have you been induced to change your life and conduct, and to what extent do you purpose, with God's help, to obey these, his just and good laws, in future? Have you truly repented

of all your past errors, and earnestly implored, through the merits of his atoning Son, the pardon of a highly offended Father?

160. Let us hope you will be enabled to keep any wise resolutions you may form; as we are quite certain you cannot lead a healthy, happy life, unless you do so constantly. How delightful it is to think, that if you always strive to do this, praying for spiritual aid to help your infirmities, you will be permitted to call the most wise and powerful of all Beings your Heavenly Father! May He be with you, to do you good in time, and bless you in eternity.

161. But thus far we have been chiefly engaged, in treating on the *matter* of which our body is formed, and the laws by which it continues, for a time, to "live and move, and have its being." In all these things, man, proud and haughty as he sometimes is, differs little "from the beasts that perish."

162. We must now, however, proceed to consider him as a sensible and a rational being; the first, by his Nerves through his senses, which give a knowledge of external objects; and the second by his Mind, through the brain, enabling him to reason upon, and draw practical conclusions from the knowledge he thus acquires. The business of life is conducted by the intelligent use of both.

LESSON XV.

On the Nerves, Senses, and the Brain.

163. If you touch a stone, a piece of wood or iron, you feel it; and by that means alone, you can form some idea of the substance and figure you have touched, without producing any corresponding effect on or in the inanimate object. But you do produce less or more effect, by patting a horse, dog, or other animal on the neck, or even by speaking to them.

164. This remarkable difference arises, from animals having nerves, extending from the organ of sensation, the brain, to every part of the body, (like the arteries from the heart,) bringing intelligence, so to speak, of all that is going on within reach of the sight, hearing, smell, feeling, or taste; and also, taking back instant orders, quick as thought, to every point, what is to be done in consequence of the information received.

165. A few years ago it was discovered that the nerves are hollow tubes, and contain a very subtle transparent fluid, which is, very likely, the medium of sensation. Fig. 10, represents this fluid flowing from the lower ends of a bundle of nervous fibres magnified. We may consider a nerve, as something like the connecting wire of an electric telegraph, carrying, when required to do so, instant intelligence, by a kind of motive sense, to the point where it is wanted for use; while the arteries may be compared to a railway, by which bodily substances are really carried from place to place, in regular order and time.

Fig. 10.

166. The matter of which the nerves consist is rather soft and pulpy, and they generally run in pairs, from the brain or the spinal marrow, to all parts of the body; for wherever there is feeling, there must, of necessity, be a nerve or nerves. A pair of nerves is composed of one cord for giving feeling or sensation, and another which gives motion. We owe the discovery of this important distinction of the nerves to the late Sir Charles Bell, the eminent Scotch physiologist.

167. The brain may be said to consist entirely of nervous matter, folded up and filling the skull or cranium, which protects it from ordinary external injuries. Three fine membranes, or thin skins, also cover its substance, which is of a pulpy consistence, being of a grey colour without, and white within. In the interior there are several cavities or spaces, (see *e*, Fig. 11,) two of which are rather large. A clear fluid is constantly distilled into them from the surrounding matter, and, in health, immediately absorbed

again. When not thus absorbed, it forms the disease called "water in the head," or hydrocephalus.

168. The spinal chord descends from the back part of the brain, and may be considered as the great trunk, from which the nerves branch off to all parts of the physical frame. One of the most important and interesting things belonging to the nerves, is the difference in the offices they perform for us, and the variety of information they bring to the mind.

169. By far the largest class are merely nerves of feeling or touch, and nerves of motion. It is, however, by the optic, or seeing nerve, that we see all objects; the auditory nerve enables us to hear; the olfactory nerve to smell; and other nerves, about which there is some dispute among physiologists, give the sense of taste.

170. To make these matters more clear, Fig. 11 exhibits

Fig. 11. A side view of the human brain.

a side view of the human brain, with the upper portion of the spinal marrow, *f*, called the *medulla oblongata*, descend-

ing from it, sending off a great number of nerves for various offices; the upper and largest mass of brain is called the *cerebrum*, and the lower portion behind marked *a*, is named the *cerebellum*.

171. You will readily know the nerve running to the eyeball, to be the optic nerve; *b*, is the olfactory, or smelling nerve; *c*, the auditory, or hearing nerve; and *d*, is called the *glossopharyngeal* nerve, chiefly supposed to give taste. One of the large ventricles of the brain is seen at *e*, and *f* shows the spinal marrow.

172. Wonderful and mysterious as each of the senses appears, perhaps, that of *sight* is most so. Before we can see any thing, a distinct picture of it must be formed in the inside of the eye, on a space where the optic nerve is spread, of less than half an inch in diameter; and yet we are able to see all the prominent objects in a landscape of 25 or 30 square miles, without their being at all confused; though the image of a good-sized house, seen at six miles, distance, would not exceed the 5000th part of an inch in breadth! Can human pencil equal this!!

173. The *ear* is also very curious. The external ear serves as an ornament to the side of the head, and for catching sounds, which are conveyed along the small opening in the ear till they strike the *drum* of the ear, an elastic membrane at its inner extremity, attached to the bones forming the interior of the ear in the way that parchment is attached to the end of a common drum. The hollow drum of the ear being full of air, sound is formed by the air striking against its outer side: a chain of small bones then conveys sound to the auditory nerve, which communicates it to the brain.

174. *Taste* and *smell* may be considered as a modification of the sense of feeling. The extremities of the olfactory nerve ramify on the membrane lining the inside of the nostrils; and all vapour or effluvia contained in the air passing into the nose, is thus brought into contact with the nerve of smell, and an idea of it conveyed to the brain. The nerve of taste, in like manner, ramifies under the membrane covering the tongue and palate, and conveys

to the brain an idea of the taste of those things entering the mouth, as food and drink.

175. God has thus, in his great wisdom and Fatherly love for us, provided all these channels for conveying means of enjoyment to the organ of feeling, sensation, emotion, reason, and mind—the brain. All the knowledge we acquire is here treasured up, ready for use at any moment in future life, if our memory be good, and our intellectual powers are well trained. See secs. 198 to 206, and 327 to 334, how to train and use all our powers correctly.

176. It is quite evident, that the brain cannot be like a common, unarranged storehouse; as the mind, by this its organ, both receives and uses *all* kinds of knowledge; and deduces or discovers, as it were, new facts, by its powers of reflecting and reasoning on the things already known. So the brain must consist of *separate*, and in a great measure, *distinct parts*, properly classified; and powers of action capable of working together, or independent of each other.

177. Men of science say, there are thirty-five of these separate and distinct departments or organs in the human brain, to which they have given names, and tell us their particular employments, or offices. When you are sufficiently advanced in learning, and are inclined to study phrenology, you will find many things in the science, both interesting and useful. For the present it is quite enough, if you clearly comprehend the fact that the brain, the seat of mind, like the body, consists of various members.

178. God has given most of us feet to walk, hands to write, eyes to see—and also powers of mind to love, hate, judge, reason, condemn, approve—with an almost unlimited *choice* of means, for exercising these powers of body and mind. He does not force us to use them in any particular way, but, leaving us great freedom of *will*, He rewards the proper culture of such powers and talents as he sees fit to confer upon us, or suffers punishments to follow the neglect or improper culture of them. The most certain way for attaining happiness is, to *train* and

use ALL these powers aright, especially the moral faculties of the mind, and the spiritual powers of the soul, which are capable of very great improvement in youth.

179. It is this almost heavenly principle of man's nature, that makes him *Man;* and however great, noble, virtuous, or holy he may be, all he is, and has, is too little to give his Creator for this one blessing, the improvability of his nature; for it is some earthly compensation to man, for the loss of Eden. If he does not avail himself of this principle when he can, he is fallen indeed!—Will you?—If so, the three following Lessons will be a great help to you.

LESSON XVI.

On the Application of all these Laws, to the Promotion of Physical Health.

180. SUPPOSING you clearly to understand the physical law of our nature, that the body is entirely made from, and supported and sustained by, the blood; and that the heart sends the blood, with nearly equal force, to every part of the body, if not obstructed; we now proceed to show, what use *you* can make of these important principles of our nature, for the increase of *your* future health and happiness. Read again, carefully, Lessons ix. and x.

181. To have the blood in a healthy state, it is necessary for us to take a sufficient quantity of wholesome nourishing *food;* never eating till we can eat no more, or leaving off while we are hungry, if we can help it; and it is by far the best, to have our meals regular, as too long fasting does much harm, in time. The food ought to be much more nourishing, if the labour be very hard or long continued, than when it is easy. See secs. 26 and 27, 45 and 46, 217 to 223, and 228 to 244.

182. A proper quantity of liquid to *drink* is also necessary, to make and keep the blood healthy; the best rule

being to drink when, and *only* when, you are thirsty. Water is the best, as it forms the basis, of all drinks. Milk is also a very nice, good beverage, when it agrees with the stomach. Any liquid agreeable to the taste, and of a cooling tendency, may be taken; but all drinks containing, or consisting of spirit, heat and inflame the blood, and if used constantly, diminish health and shorten life, materially. See secs. 40, 41 and 42; 199 and 200; also THIRST, sec. 300.

183. But *fresh air* and *exercise* are quite as needful as food and drink, for keeping the blood in a healthy state. Reasons for the first, are given in Lessons xi. and xii., which should be read again now. Without exercise, the body would become feeble and delicate, life being rather a burden than a pleasure. The blood, being little wanted to supply waste, would circulate slowly, and require little air to purify (oxygenate) it; for merely breathing quickly, unless we take exercise to cause a large flow of blood through the lungs, will not do this.

184. When those who take little exercise, require to make any sudden effort, the waste matter from the parts affected, wants to get away all at once, and almost chokes the vessels; like the mud in a suddenly swollen mountain-torrent or river. But a well exerted body is not liable to this, and bears even extraordinary efforts much better. Labour is exercise of the best kind; those who need not to labour, must work both body and mind, either in doing something or nothing, if they desire health.

185. Nor can health and strength be long continued unless the skin, *all* the skin, is washed frequently, with a sponge or other means. Every morning is best, after which the skin should be rubbed very well with a rough cloth. This is the most certain way of preventing colds, and a little substitute for exercise, as it brings blood to the surface, and causes it to circulate well through the fine capillary vessels. Labour produces this circulation naturally. The insensible perspiration cannot escape well, if the skin is not clean, as the pores get choked up. Frequent bathing and washing is, therefore, very important.

186. It is also a law of our nature, that we cannot secure a continuance of health, without a due proportion of *rest*, *recreation*, or amusement; and, of the balmy restorative *sleep*. The evil effects arising from neglecting any of these may, if we have a good constitution, be long unfelt; but they are certain to come, as every fresh error registers a new account, and a few short years reveal the unsuspected fact of premature old age, by decrepitude, and death!

187. These laws affect each part or member, as well as the whole body. If, for instance, we ceased to use an arm, less and less blood would go into it; till, in time, it would become feeble, torpid, and lifeless; as is the case with the limbs of some Hindoos, who dedicate them (as they say) to one of their cruel gods, and then cease to use them. When any limb or other part of the body is much used, the reverse takes place; much blood naturally flows to it, if not obstructed, and in time, it becomes far more strong and vigorous than it otherwise would have been; if care be taken not to *over-task* it, which is as bad as not using it sufficiently.

188. You have full examples of these laws, in the strong arms of blacksmiths, millwrights, joiners, and all such as make constant vigorous use of their arms; also, in the nimble fingers, and often weak legs of tailors and writers; and in mechanics, and all other *constant* workers being active or strong, for their size, according to the nature of their several regular employments and their general temperature: and the proper supply of food, drink, fresh air, rest, and sleep they get.

189. But you must never forget the main principle, that it is from *years'*, not days', or weeks' observance of these laws that good is to be attained; and that *youth* is the chief, indeed almost the *only time*, for doing it, as the difference between effecting a change of this kind at the ages of ten and forty, is about as great as the difference in the power necessary to bend a young, and a full-grown tree. Good habits should be formed early in life.

LESSON XVII.

On the Improvability of our Intellectual Powers.

190. The most important advantage man derives from the laws explained in the last Lesson is, that they apply with equal or even greater force, to the mind, than to the body. For the mind, being seated in, and acting by or through, a material organ, the brain; is weak or strong, quick or slow, well or ill disposed, according to the size,

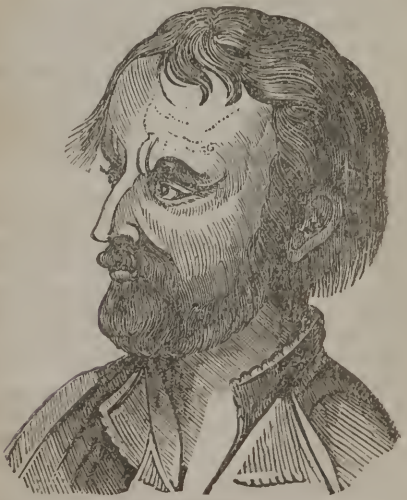


Fig. 12.

texture, form, and activity (while mental health continues) of the organ in which it is situated.

191. The brain, and each department of the brain, is governed by the same physical laws as every other part of the body; being made from and sustained by the blood, just as they are. Some people have strong bodies, others strong minds; some are mentally and bodily active, while others are very dull and lifeless; and some there are, who possess great powers of body or mind, but never use them; or, what is worse, only use them to do evil. All the powers of the mind admit of great improvement or modification in youth, by proper culture; whatever their original constitution may be.

192. It is not the largest man, or the largest mind, that always does the most work. Besides having power, he also requires a *will* and knowledge how to use it aright; and after all, there are such things as mental and bodily indolence in the world. Do you know what they are? If you have ever seen a giant and a dwarf, you will be able to form a tolerably clear idea of mental giants and dwarfs, by comparing Fig. 12, the head of a great, wise, and good man, with Fig. 13, the head of one whose

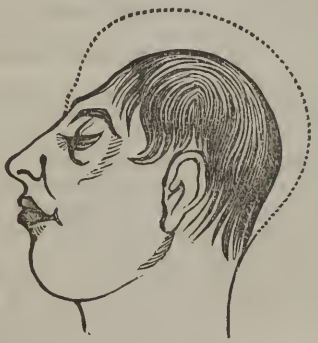


Fig. 13.

mind was very weak and childish. The dotted line in Fig. 13 shows the volume of brain wanting.

193. You will observe that the head of the former exceeds the latter in size, chiefly in the upper and particularly in the front part, the brow. It is here that the best powers and principles of the mind dwell; and it is only by a careful and industrious cultivation of them in youth, that you can secure their full development, and vigorous, well-directed activity in after life.

194. The minds of idiots are often capable of very considerable improvement, but unfortunately, the reverse generally takes place. It is their mental powers that most require improvement, but these, being entirely neglected, and their animal feelings and passions so much drawn out and exercised by the ill treatment of those who plague (instead of pitying and consoling) them; they generally get worse unless their friends take proper care of them. Did you ever torment such a person?—Might you not have been made as they are?

195. What a blessing it is to think, that however feeble any of the mental powers with which you are endowed may be, they are capable of very great improvement in youth, if you follow the advice and instructions of your parents and teachers, whom God has set over you, to guide you for a season; but this golden opportunity once lost, is lost for ever.

196. Are you not ready to exclaim, "And has this great, good, and ever watchful Being, done all this for *me*, while I have been thinking so little about *Him*—neglecting, yea, even disobeying, many of the best of His laws; and thinking lightly of the experienced counsels and disinterested advice and instruction of those guardians, whom He knew my ignorance and helplessness in youth would require, and which *His* goodness has so fully supplied."

197. "Teach me, oh! help me, to serve, obey, and love Him, and them, better every day I have still to live." If such should be your real feeling, let us hope the next Lesson will aid you much in your wise and prudent course; but remember, the help of others will do you no good, unless you heartily and constantly *do*, that which they show you is best to *be done*. You must exert yourself, and

make a serious study and business of preserving your health. It is your life.

LESSON XVIII.

On the Improvability of our Mental and Moral Powers.

198. The first step to be taken in doing that which you seemed so anxious to set about, at the end of the last Lesson, is, to see what has hindered you from beginning this necessary and important work, till now. Perhaps you will say, it was a want of knowledge on the subject; if so, that is in some measure removed, but if you examine yourself closely, you will find other causes even more difficult to remove than this.

199. He who made you has, for wise purposes, given you animal feelings and passions, which require all the aid you can get to subdue them and bring them fully under the control of your moral powers, or the better feelings of your mental nature. For instance, he has conferred on you the animal pleasures of eating and drinking, that you may thus be induced to take a sufficiency of food and drink regularly, to sustain you in health and strength; and even made it painful for you long to neglect these vital duties.

200. But if you act as though you merely live to eat and drink, instead of eating and drinking to live; and because God has made it pleasant to obey these laws of our animal nature for one purpose, you should indulge yourself in practising them for a totally different purpose, you would thus pervert his laws, and bring on yourself punishment, according to the strength of your constitution, and the extent of your transgressions. We should eat to live, and not merely live to eat.

201. You see here, how necessary it is for the moral sense of right and wrong to step in and forbid such things; and not to do this in a feeble or jesting manner, but with

most resolute firmness; in spite of all that taste may say about the pleasure to be enjoyed, and the *very little* harm such a small indulgence can do. Keep constantly in mind the fact, that every time you indulge these feelings, they become more difficult to subdue, for two reasons depending on the same law. The passion becomes stronger, from being exercised; while the moral power which should keep it in check is weaker, from *not being* duly exercised.

Fig. 14.

202. You will be able to form a more clear idea of the growing, and strengthening of the brain; and the wise provision that is made to admit of this being done to a very great extent in youth, by looking at Fig. 14, which shows the back part of the cranium or skull; and the jagged lines that mark its three divisions during infancy, childhood, and youth are plainly seen.

203. When the whole powers of the mind and brain of a child or young person are duly and properly exercised, constantly, so far as their constitution will bear; a vigorous, healthy flow of blood ascends to aid in the action of the brain, and its several parts, and promote their growth. This swelling out, so to speak, of the brain, causes it to press the inner side of the skull; which being, as you see, in three parts, can yield to this pressure from within; and growing larger at the edges, as well as in other parts, can thus easily accommodate itself to your commands, either to enlarge very slowly, or very fast during youth. It is very wrong, however, to force the development of the brain in children by early and severe studies, as that course endangers the whole nervous system.

204. But in after life, those divisions all join, and the

three pieces of the skull become one bone; when it is almost impossible for any further growth of the brain to take place. If before this you duly develope the whole brain, by a constant exercise of the intellectual, moral, and spiritual powers, and keep the animal feelings and passions under the control and guidance of those highest faculties, you do well.

205. If, on the contrary, you should unfortunately not have done this, or what is worse, have indulged your animal propensities to excess, and neglected all the high and delight-giving endowments of your mind, your case will be bad indeed. You will truly have made rods for your own punishment, and placed them in the hands of Satan; who will not be sparing in their use, through the medium of your carnal, ever active, and sinful nature.

206. Let us hope these simple Lessons may become a powerful means, under the Divine blessing, in preventing this calamity; for no human means can prevent it, unless we obey the physical and mental laws of our nature, which we have been trying to make plain to the humblest mind.

207. Never forget that it is only by a *constant* obedience of ALL God's laws, that you can obtain the greatest amount of happiness in this world. It is not by obeying all, for a few days or weeks; or, by practising a few of them through life, that the full reward is gained by man. God will not have a divided heart, and he promises happiness to man here, only on condition that all his physical, moral, and spiritual laws are kept; for however holy our lives may be, if we neglect to nourish and exercise the body and cultivate the mind, we rob ourselves of much comfort, and greatly diminish our temporal and spiritual usefulness.

208. Man cannot grant to man exemption from this. These laws are as binding on the rich as on the poor; no order, station, or condition, can here claim any peculiar privilege, or indulgence. All who wish to secure happiness, must obey, in duly supporting the body and mind with those things that are needful; and in exercising the physical frame, the intellectual and moral faculties of the mind, and the spiritual powers of the soul, *every day*.

209. And what easy conditions, on which to gain so great a blessing. Does it not appear as if God said to man, "I have so framed my laws as to give thee the greatest amount of happiness thou art capable of enjoying, if thou only knowest and obeyest them; and even this obedience, which, at first, may appear hard to thy carnal nature, will soon become thy greatest pleasure." Lord, grant that the time may soon come, when all men, of every clime and colour, shall obey thee in all things! and Christ reign triumphant in every mind. Such a consummation will ultimately take place through the co-operation of man himself.

HEALTH MADE EASY.

PART II.

210. THOSE laws, principles, and organs of our physical nature most necessary to be known by Young People, and most certain to secure them as much of that best of blessings, Health, as can be attained in this life, having been compressed into the First Part of "*Health made Easy*," for THEIR use; let us now investigate the remaining parts of our physical structure, and the laws affecting them.

211. To adults, especially teachers, parents, and all who wish to teach themselves, many of these things will be found essential; and to all, very useful and interesting. Some passages in the text, however, admit of, and seem to require a little further illustration, for promoting their extended practical application in society, by arguments and additional facts, which may be more usefully given here than in the First Part. The first illustration of this kind is, on the latter part of

212. *Section* 7th.—"God never confers on man the worldly advantages developed by new discoveries, till after they are made and brought into use. It is, therefore, difficult to conceive, *why* all his physical laws were created and formed so well suited to make man comfortable here, if they are *not to be* discovered and applied, as man cannot obey them, if he does not know them."

213. People who care little about, or are opposed to the physical, religious, social, or scientific investigations, discoveries, and improvements made by man, are much to be

pitied, as they wrong themselves, society, and their Creator. The humblest-minded man smiles *now*, when he reads of the ridicule cast on such men as Harvey, for discovering and publicly lecturing on the circulation of the blood; and on Galileo, for teaching the true motion of the heavenly bodies. The blood stopped not in man's veins, for all the laughing at, and opposition to, Dr. Harvey; and the earth, and all the other planets, went quite as fast in their true courses, all the while Galileo, under the impious threats of worldly power, was compelled to write, that they "did not move."

214. Many will talk much of the ignorance, and of the barbarous customs that prevailed in past ages, or still prevail in distant countries, and seem to lament the loss of human life caused thereby; while they are themselves doing, or permitting to be done, things as inimical to health and life, as those whom they so loudly condemn. Does any one doubt this, and ask for proofs? they have them—in almost every face they meet with disfigured by small-pox, or frequent crying caused by the bad nursing of infants—in every house built on marshy ground, or in a badly drained, close, and ill-ventillated street or court—in every room not properly aired—in every unnatural small waist—and, in a long catalogue of other physical and moral transgressions of God's laws, still lamentably prevalent in our own enlightened day.

215. There must be a cause for every disease and ill that afflicts mankind, which cause is, at least, permitted to operate by our Creator, if not actually designed as a punishment, for disobeying some law or laws. When man finds out the means for mitigating or removing any of these causes, and their painful effects, those means must have been created, with all their healing properties and life-giving principles, by the same Divine being; for, though man may discover and apply laws and things, he cannot *create* them. Is it not then absurd, as well as impious, to say doing these things is not pleasing to God, if we admit that He *desires* man to live and be healthy.

216. Perhaps the most strange and anomalous part of

man's conduct in these matters, is, the very great care he bestows on the selection of animals from which to breed his stock, and even the seed corn for his bread; while he leaves all similar things connected with his own family, almost entirely under the guidance of his lower or animal feelings. He acts as though he thought man were placed too high in the scale of animal existences to be affected by the physical laws of his Creator; and seldom examines, whether his own bodily and mental constitution are such as he would like to see inherited by his children; and more seldom is he influenced, in these things, by the same enlightened principles which he so strictly observes in other matters of infinitely less importance. How can we be actuated by intellectual love, while we utterly disregard the precept, "whatsoever a man soweth, that shall he also reap?"

217. *Section* 51.—"Animal and Farinacious food digests in about one half the time of vegetables, though the mode of cooking food affects its digestion." The following classification of the most common kinds of food, with the time they take for complete digestion in a vigorous, healthy stomach, may be of considerable service in the selection of food for different purposes, either in health, or sickness. The classification is from Majendie, and the time of digestion is taken from the results of Dr. Beaumont's experiments, named in Sees. 53 and 54; these experiments having been made when the body was in the best health, and the mind in good spirits. The mode of cooking each article is given in parentheses:—

218. *Fibrinous* food.—Venison steak (broiled), 1 to 2 hours:—Beef (boiled), Turkey or Lamb (roasted), 2 to 3 hours:—Beef lately salted (boiled), Mutton (broiled or boiled), 3 hours:—Beef or Mutton (roasted), 3 to 4 hours:—Domestic fowl (boiled), Duck (roasted), fresh Beef or Animal Heart (fried), 4 hours:—and Soup of Beef and Vegetables, Wild Duck (roasted), salt Beef (fried), Mutton Suet or Gristle (broiled), take 4 to 5 hours to digest.

219. *Albuminous* food.—Eggs (raw), 1 hour:—Brains of Sheep (boiled), Trout (boiled), 1 to 2 hours:—Codfish (boiled), 2 hours:—Oysters (raw), 2 to 3 hours:—Eggs

(boiled soft), 3 hours:—Eggs (boiled hard or fried), 3 to 4 hours:—Flounder or Codfish (fried), Oysters (roasted or stewed), 3 to 4 hours:—and Salmon (salted, dried and boiled), take 4 hours to digest.

220. *Gelatinous* food.—Tripe (boiled), 1 hour:—Chicken or Sucking-pig (roasted), 2 to 3 hours:—Chicken-soup, 3 hours:—Veal (broiled), 4 hours:—and fresh salted Veal (broiled), 4 to 5 hours to digest.

221. *Fatty* or *Oily* food.—Pork (stewed), 3 hours:—Porksteak (broiled), 3 to 4 hours:—and Bacon (boiled), 4 hours:—and Bacon (fried), takes 5 hours to digest.

222. *Cheese-like* food.—Milk, (boiled), 2 hours:—Raw milk, 2 to 3 hours;—Cheese (toasted), 3 hours:—Cheese (raw), takes 4 hours to digest.

223. *Farinacious* food.—Rice (boiled), 1 hour:—Sago (boiled), 1 to 2 hours:—Tapioca, or Barley (boiled), 2 hours:—Sponge bread, Broad beans, or Potatoes (boiled), 2 to 3 hours:—Bean soup, or Wheat cake, 3 hours:—and Wheaten bread (baked), 3 to 4 hours.

224. *Mucilaginous* food.—Carrots, Beets, or Turnips, (boiled), take 3 to 4 hours to digest.

225. *Saccharine* food.—Sugar-cane, Figs, Dates, Plums, Peaches, &c.

226. *Acidulous* food.—Oranges, Apples, Pears, and other fruit.

227. *Aqueous*.—Water about 1 minute, and other water beverages according to the digestible nature of the matter they hold in solution.

228. The experiments from which the time of digestion is given, were chiefly made on one article of food at once; and not, as in ordinary meals, placing two, three, or four kinds of food in the stomach at the same time. We must, therefore, bear this fact in mind, and take into our account the time *each* article eaten at the same meal, will require for its complete digestion; as well as make allowance for the state of our health, (bodily and mental,) and the vigour or exhaustion of our strength, all these things materially affecting digestion.

229. The time taken to digest any kind of food, does

not, however, show the proportion of nutriment it gives to the body. A pound of rice would give far less strength to the body than a pound of raw eggs, though both digest in about an hour, or a pound of roast beef, which would require near four hours for its digestion. As a general rule, *Fibrinous* food is the most nutritive and stimulating; *Albuminous* food being almost equally nutritious, but far less stimulating. *Gelatinous* food is less nourishing; while that of a *Fatty* or *Oily* nature, is only fit for stomachs possessing very strong digestive powers. *Cheese like* food is also very nutritious; but none of the above five ought to be taken without a due proportion of *Farinacious*, or *Mucilaginous* food being eaten with them; this proportion being regulated according to age, nature of employment, health, strength, &c. Many laborious people enjoy health and long life, who live entirely on the two last named kinds of food; and whole communities in the East live almost entirely on rice.

230. During infancy, the best food is that which nature provides, milk; as it contains every element needful for, and best suited to, the nourishment and growth of the body. No food should be given requiring mastication, till infants have teeth. *Fibrinous* food should be given very sparingly, till the age of 6 or 7; and not at all when it causes a flushed face in the evening; as children require nourishing, but not stimulating food. They should have enough to eat, plenty of fresh air and sleep, with as much exercise as they can well bear. When a child becomes pale, and its flesh feels soft and flabby, there is reason to fear its diet is not sufficiently nourishing. Much attention should be paid to this, the diet and exercise being regulated by the firm feeling of the flesh in grasping the limbs of children or adults, and the exhaustion, or physical vigour they feel.

231. The quality of the food we eat, is also of much consequence. Bread that is well leavened and nicely baked, digests much sooner, and gives far more strength to the body, than if either or both had been badly managed in making it. One pound of the flesh of a well-fed three year old ox, will give as much strength to the body, as 2

or 3 pounds from an old lean animal. The lowest priced meat will always be the least profitable for use, while so many of those who buy are guided in choice by quantity only; as demand governs the relative price of good and bad meat. We ought, at all times, to be very particular that our food is wholesome. Unwholesome food is one of the great causes of sickness.

232.—Section 80.—"If our food, drink, and air, are not such as to furnish nature with the means of getting all she wants, some parts become deficient in time, and the health must suffer. A great variety of food is, however, not necessary—the quantity and quality are most important. Take enough, but no more.

233. Few things excite more surprise than the great variety of ingredients nature extracts out of even one or two kinds of food. See, for instance, the cow, living for years on grass or hay; out of which her stomach obtains matter for making milk, butter, flesh, fat, bone, horn, hoof, skin, hair, &c. The ass will live on the most scanty fare, and yet nature seems to accommodate herself to it, this ill-used animal often performing very hard tasks. There are men who will live many years, and scarcely ever eat any thing but rice, or even potatoes, though they eat a large quantity, performing a considerable amount of labour, and appearing as healthy as if they had a little animal food; though they may not be quite so strong or able to bear excessive and long continued toil so well. Shipwrecks and other disasters sometimes give us astonishing instances of what a well fed, hard worked, and properly seasoned veteran can endure; and how soon those not so prepared for hardship sink under it.

234. All the kinds of matter in the blood necessary for health and life, are soon exhausted, if food and drink are entirely withheld from the individual; though if water can be obtained, life continues much longer. When the supply of food and drink is, from any cause, reduced to a very small quantity, the blood gradually becomes impoverished, till it is chiefly water; and if this be still continued, death must follow, the time depending on constitution and other

circumstances. If great bodily exertions have to be made, or the mind be harassed by constant fear, death occurs much sooner than when the body is more at ease, and the mind constantly cheered by hope.

235. A poor and scanty diet, or excessive and prolonged toil, either bodily or mental, produces similar effects, though in a much less dangerous degree; but when they are continued, the body becomes enfeebled, the constitution gets broken down, and some disease comes in, to produce fatal results; or if the constitution be more than ordinarily strong, it is impaired so much as to make the remainder of life miserable, should these transgressions of God's physical laws cease before death relieves the sufferer.

236. We cannot make an effort, move a limb, or even think a thought, without some waste taking place in the part exerted. In health, the blood supplies this waste from its abundant store of vitality, and its healthy state is improved thereby. But when the body is weak and exhausted, especially if labouring under disease, exertion produces far more waste than the same efforts would have done in health and vigour; and nature's means of repairing the loss thus sustained are then at such a low ebb, that she requires far more time to restore the lost strength.

237. The vital stamina in the blood may, in some respects, be considered like the water in a mill-pond. When the reservoir is full, the water can be poured into the buckets of the water-wheel at the highest point, and exerts the greatest possible amount of power. If the reservoir should be allowed to get nearly empty, the case is however quite reversed, the water coming on the wheel at such a low point, that it can exert little or no power.

238. So when the body is in full vigour, the stamina of the blood is rather improved than impaired by exertion, as any surplus matter requires forcing out of the body by increased secretions, if little or no exercise be taken; just as the surplus water runs to waste through the flood-gates of the reservoir, when not used by the mill. In a weak or sick state of the body, when the blood is thin and impure, exertion soon exhausts the stamina; and should,

therefore, be made with caution, just as much, and no more, being taken *every day*, as can be borne without fatigue. Fatigue exhausts the system.

239. Most diseases are caused, either directly or indirectly, by a deficiency or an excess, in the due proportion of some one, or more, of the kinds of matter necessary for keeping the blood in a healthy state. An excess of matter in the blood may arise from three causes; the diet being too rich and nourishing—the body and mind being too little exercised—or from the suppression of some necessary bodily secretion; such as the bowels being in a restringent state, the kidneys or liver inactive, the stopping of the usual amount of perspiration, or any other of the secretions. (See secs. 297, 298.)

240. The partial or total absence of any particular kind of matter from the blood, necessary for giving healthful vigour to the body, may be caused by living on a poor, unwholesome, or scanty diet, or eating at very irregular times—too much labour of body or mind, or fits of excessive labour and rest—loss of sleep—great anxiety of mind, or considerable discharges from the body of any kind, especially those that weaken it much. (See secs. 297, 298, on the secretions.) Matter unnatural to the blood is also frequently infused into it by the use of alcoholic beverages, breathing impure air, poisonous substances being taken into the stomach, or forced directly into the blood by the bite of a venomous creature; and in many other ways by which the vitality of the blood is so far impaired as to cause immediate death, or long and painful disease. Drinking wine, beer, or spirits is particularly deleterious, from its direct action on the blood.

241. When the blood is only slightly affected by any of these grand causes; such, for instance, as a cold, by which the perspiration has been suddenly stopped, and, being kept in the blood, causes a little disordered feverishness—in cases of severe headache from the effects produced on the nervous system by the quantity of alcohol taken the previous evening; or any other trifling *single* error by which

the healthy state of the blood is a little deranged; nature soon recovers herself, if allowed fair play, and similar transgressions of God's physical laws are discontinued. Our allwise Creator has, in mercy to sinful man, opened many secretory outlets for the escapement of noxious matter; and inlets, for its replacement, by that which is promotive of health and vigour.

242. Should these sins against the laws of health unfortunately be continued, nature becomes obstructed in her sanatory efforts, by the accumulation of poisonous matter in the system, or enfeebled for want of proper nutrition; and some of the vital organs, from being too long disordered, become diseased. The physician's difficulties are then increased, by his having two things to effect at the same time; he can, however, neither remove the cause of the complaint from the blood, nor heal the diseased organ, till God's laws are obeyed by the patient.

243. All medicines have been created with certain properties implanted in them, which operate on the human body according to the state it may be in at the time. Many doses of physic that will cure disease, would kill, if taken in health. The effects to be produced by medicine, therefore, depend chiefly on the skill and judgment with which they are administered. But, however much a medical man may know of the healing properties of the agents he employs to restore lost health, or however well he may be informed as to the real state of those whom he endeavours to relieve or to cure, he will labour in vain, if the patient still disobeys the laws of health. No earthly physician can give the smallest amount of a *new* property to medicine, or *create* a new one to do that which God has, for wise ends, ordained should not be done by human agency.

244. Every one who reflects on the infinite variety of constitutions found in the human family, and the innumerable ways in which those constitutions are affected by the grand causes of disease named in secs. 239 and 240, will see what experience and skill are necessary to secure

success in the art of healing a frame so "wonderfully made." No human employment requires more knowledge or caution; and man is fully as likely to be freed entirely from "all the ills that flesh is heir to," as to discover a universal medicine, that will cure all complaints. A medicine of this kind should never be used. If powerful, it is dangerous. If weak, it is useless.

ON THE BONES, MUSCLES, &c., &c.

245. Let us now proceed to the investigation of those parts and functions of the human structure, and the laws affecting the body, that were not so proper or necessary to be noticed in the First Part. If these are not so much required for the young, they will be found quite essential for adults; and, at the same time, very interesting and useful to be known. The most important of them remaining to be noticed, are

246. The Bones, and bony frame-work; forming, as it were, the foundation of the human edifice: they give firmness and stability to each part, and to the whole fabric. Bone chiefly consists of lime (united with an acid composed of phosphorous and oxygen) and animal glue or gelatine; the latter, abounding most in the bones during youth, while in old age, they are composed of a much greater proportion of lime. During the prime of life the bones consist, on an average, of about one-third earthy, and two-thirds animal matter; but the proportion is very different in bones belonging to the same body; those that are the hardest containing the most lime, while the more supple ones are made chiefly of gelatine. The bones of infants are formed almost entirely of this substance, being little firmer than gristle.

247. The total number of bones in a full-grown, perfect human being, is 254, connected together by 180 joints;

and they weigh from 10 lb. to 13 lb. when divested of all other matter. The head, trunk, and limbs, may be considered the three grand divisions of the skeleton; the first and last division containing the strongest and heaviest bones, for their size. Those of the limbs are mostly hollow, like pipes, to make them both light and strong, and the internal part is filled with marrow. Hard as the bones appear, blood circulates through all of them during life; and when a bone happens to break, the broken ends send out bony matter, that with care soon cements them together again. How wonderful!

248. Each bone is exactly suited, in form and size, to the place it occupies; and they are all joined together in the way best calculated to give the greatest amount of strength to each part, and admit the utmost ease and freedom in motion. The bones are covered by the *periosteum*, a very thin membrane; their ends at the joints are covered with very smooth gristle; and a kind of oil, called *synovia*, is secreted or poured into the joints, to make motion as easy as possible; but if the body is much tired, this oil cannot flow so fast, the joints feel painful in moving, and after long continued fatigue, the body will from this cause be a little shorter than its usual stature.

249. As the bones are principally known by anatomical names, the easiest way of giving information about them will be by engravings. In Fig. 15, a man will be seen at full length; with the fleshy parts of the body engraved in such a transparent manner that the bones are seen through it so plainly as to afford much aid in describing the osseous fabric; and give an idea of the position, office, and forms of many of the bones.

250. The skull, or *cranium*, *a a*, consists of eight bones, joined together by edges, like the teeth of a saw, or in other cases, over-lapping each other like the ridge and slates of a house; presenting altogether an arched mass of bone, in the most powerfully protective form, to contain the important organ of mind, the brain. About fourteen other bones form the front and lower part of the head, including the nose, cheeks, mouth, and jaws; besides the teeth, which, in

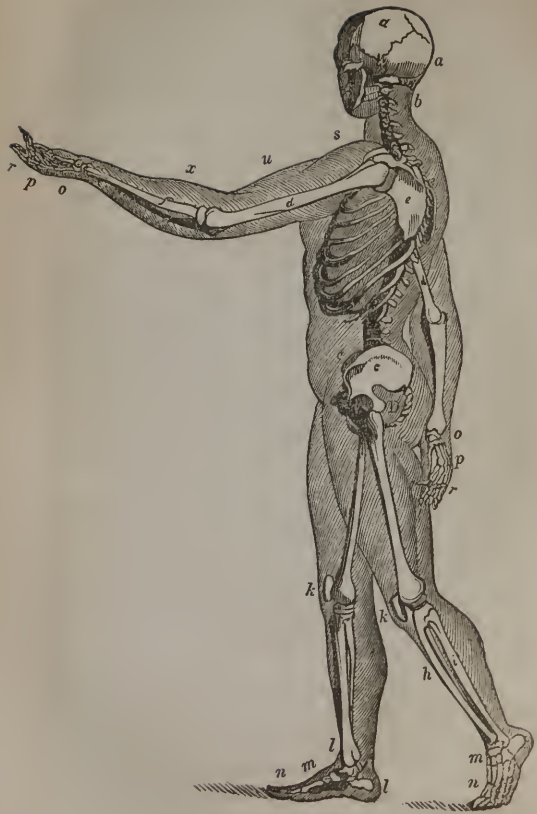


Fig. 15.

adults, are generally 32 in number. In Fig. 16, the front teeth of a child are beautifully shown; the outer surface

Fig. 16.—Teething in Childhood.

of the jaw-bones being removed to exhibit the new set of teeth at *a a*, in the upper, and *c c*, in the lower jaw, growing and pushing out the first set.

251. The head is curiously joined to, and rests upon the spine, a wonderful column of 24 bones, knit together in the firmest possible manner; yet, at the same time, admitting the most free and easy motion. In a young child, each of the 24 vertebra consists of three bones. The upper portion of the spine, *b*, forming the neck, consists of seven bones, called, from their position, *cervical vertebra;* and some idea of their form may be obtained from the annexed engravings of the two first, or uppermost of them, drawn on a much larger scale than the bones in Fig. 15.

252. The under side of the first, or highest vertebra,

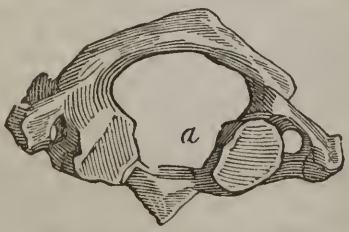


Fig. 17.—Atlas vertebra.

(called the *atlas*, because it supports the head,) is seen in Fig. 17; the large aperture, *a*, being to receive a suitable projection, rising from the second vertebra, as represented

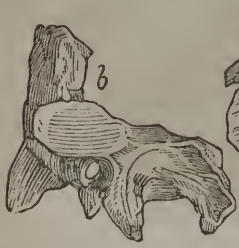


Fig. 18. Fig. 19.

at *b*, in Fig. 18, forming a sort of pivot on which the head turns, though each of the seven cervical vertebra aid in the rotatory motion of the head. This pinion, in the second vertebra, is kept firmly in its socket by a ligature or band, little thicker than strong paper, but of such extreme tenacity and strength, that it scarcely ever gives way; as instant death would be the consequence, because the upper bones would then press on the spinal marrow. Fig. 19, shows the under side of the second vertebra, being the same bone as that given in Fig. 18.

253. Under, and firmly united to the last of the cervical, is the first of the 12 *dorsal vertebræ*, curving outward at first, to make room for the heart and lungs in the chest; and, after descending to the lower point of the shoulder blades, bending inwards, so as to bring the lower vertebra of the back again into the centre of gravity, and make it easier for us to stand in an erect position. Each of these 12 bones of the spine has a rib firmly attached to it, on the right and left sides, as shown in Fig. 20; where *a*, is the body of the vertebra, (on a smaller scale than Fig. 21,) *b*, the right, and *c*, the left rib proceeding from it; *d*, the cavity for the spinal marrow, and *e*, *f*, and *g*, the three

outward projecting processes to which the surrounding muscles are fixed for moving the back-bone, and the body.

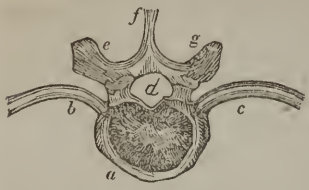


Fig. 20.—Ribs and Spine.

In females, the ribs and their joints are more flexible than in men, to admit of breathing more fully in the chest, when there is no room for abdominal respiration. The curvature of the spine is plainly seen from the erect attitude of Fig. 15; as well as the projecting *processes* of each vertebra.

254. The five lowest bones of the spine are called *lumbar vertebra*, from being situated in the loins; and the third of them in Fig. 21, shows they are much larger and stronger than the upper bones of the spinal column, having to support those above; and also aid in connecting the upper part of the body firmly to the lower. In Fig. 15, *c c*, are the two large hip, or *pelvic* bones; and the spine is firmly connected to them by the *sacrum*, a wedge-like column of


Fig. 21. The third lumbar vertebra.

five imperfect vertebræ, *b*, which sinks between the two pelvic bones, *a a*, Fig. 25, page 92; and is terminated by a loose bony peak *D*, called *coccygis*. Throughout the whole length of the spinal column, except the bony peak, *D*, a hollow channel is formed for the spinal marrow; and in the space between each vertebræ, are two large holes through which the nerves branch out from this spinal cord to the various parts of the body. See secs. 168 to 171.

255. From the twelve dorsal vertebræ, twelve ribs or *costa*, *a a a a*, Fig. 22, extend in a semi-circular form on each side to the breast-bone, or *sternum*, *b*; the fourteen uppermost, called true ribs, are each joined firmly to the breast-bone, by their own cartilaginous bands; while the ten lower ribs, *e a*, *e a*, are all joined to one cartilage or gristle, which is fixed to the bottom of the breast-bone. A strongly

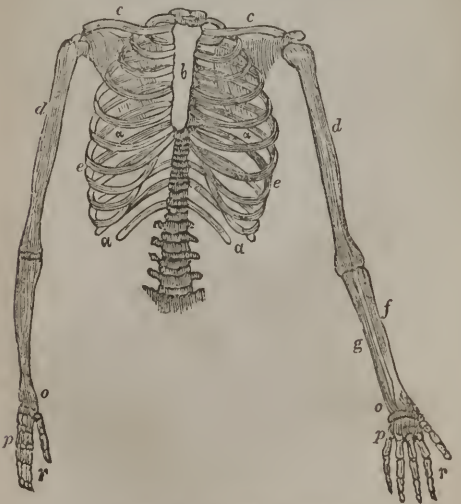


Fig. 22. Chest and Arms.

guarded cavity is thus formed, to contain and protect the more vital organs; and yet the ribs allow full and free play to the lungs, especially in the female chest, by means of the easy joints which connect them to each vertebra, and the gristles that fix them to the breast-bone.

256. At the top of the breast-bone, on each side, the *clavicles*, or collar-bones, *c c*, extend in the form of arches, to the top of each shoulder; and are connected to the *humerus*, *d d*, or hollow bones forming the arms from the shoulders to the elbow joints. The *scapula*, or shoulder-blades, *e e*, Fig. 15, are also joined to the upper end of the humerus, and, resting loosely on the ribs, aid much in giving free and varied motion to the arm. Below the elbow, two bones, *f*, the *radius*, and *g*, the *ulna*, form the fore-arm; joined to eight *carpal*, or wrist-bones, *o o*, from which the *metacarpal*, or palm bones, *p p*, four in number, extend to the fingers, *r r;* each finger consisting of three bones, and the thumb of two.

257. To the lower parts of the pelvic, or hip-bones, *c c*, Fig. 15, the *femur*, or thigh-bones, are curiously but strongly attached. They are hollow, like the single bones of the arms, and reach to the knee, where they are firmly connected to the two bones of the leg, *tibia*, *h*, and *fibula*, *i*: the knee-pan, or *patella*, *k k*, overlapping and protecting the knee-joint in front. The two bones of the leg are joined at the ancle to the *tarsus*, *l l*, seven bones forming the heel and back part of the foot; and from these, the five *metatarsal* bones, *m m*, extend to the *phalanges* of the foot, *n n*, three in each toe; except the great toe, which has, like the thumb, only two bones.

258. Neither words nor drawings can convey to the mind, clear ideas of the form and action of the numerous and often complicated joints by which all these bones are so beautifully connected in the living body, even if it was desirable to do so in such a brief outline of the component parts of the osseous fabric as this work. But the most useful facts for us to know are, that we have many bones, all made up from, and supported by the blood; that naturally, they are of such form, size, and strength, and are

so joined together, as to be of more service to us than they could be if they were changed in any of these points; and that they are less liable to disease than the softer parts of the body; though, if we transgress the physical laws of our nature so long that the bones do become affected, such complaints are very difficult to remove by any means man can employ.

259. The Muscles are equally as necessary for life, health, strength, and motion, as the bones; they give form and comeliness to the body and limbs, and consist of the leaner and firmer parts of the flesh of man and most other animals. Muscles differ much in their form, size, strength, and texture, according to the position they occupy, and the work they have to do; as lifting up the eye-lid or a finger, is a very different affair in the animal economy to lifting a leg or an arm. Every movement we perform, whether voluntary or involuntary, is done by the muscles; though it is the nerves tell the muscles what motion to make, and how to make it.

260. A good idea may be formed of the close connection existing between nerves and muscles, and their united action to produce motion, by comparing Fig. 23 with Fig. 24, which represent a portion of a muscle with the chord of nerves passing through it, sending off nervous fibres to every part of the muscle; Fig. 23 showing the muscle when at rest, and Fig. 24, the same in a state of contraction during motion. When at rest, we see the nervous cord and its numerous fibres, as it were, unstrung; and the muscle appears much larger than in a contracted state, when the nerves seem pulling the muscle in all its parts, and knitting the whole together in the firmest and strongest manner.

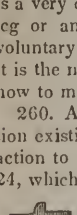


Fig. 23.

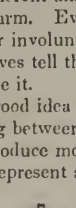


Fig. 24.

261. Each muscle consists of many threads or fibres, generally arranged in layers, sometimes in a straight, and at other times in an oblique or crooked position; and they are all very elastic, lengthening or shortening as required, with the greatest rapidity. They are of a reddish colour,

inclining to brown, generally much thicker in the middle than at either end, and mostly terminating in a very tough white cord, called a tendon or sinew, firmly attached to some bone, serving as a rope, by which the muscle moves the bone. These tendons are most numerous about the joints, and are of very intricate structure. The muscular fibres are bound together by strong sheaths, which aid their action considerably.

262. Though the skin conceals the action of many of the smaller muscles, we can see the more important ones very plainly; especially in the limbs and body of those who labour hard and have not too much fatty flesh. It is both interesting and instructive to watch carefully some of the larger muscles when in rapid action; or during the performance of great efforts, requiring all the strength. Look, for instance, at a muscular arm when laid at rest, and feel how comparatively soft the fleshy part is, either above or below the elbow; and see or feel the same when the fist is firmly clenched, or engaged in lifting a very heavy weight; and if, in doing this, the elbow joint is moved, and the weight lifted up towards the shoulder, all the muscles of the arm, and many of those on the chest, will be seen constantly changing their beautiful form, and swelling in the middle, during the laborious operation.

263. Raising the whole body on one leg, from an almost kneeling posture till it is elevated on the toes, exhibits a still better and more strongly marked action of the muscles than can be shown in the arm; and the effect is further increased if a weight can be supported during the above muscular effort. A short observation of our own muscles during motion, will lead us to look with wonder on this important part of the physical structure; especially if we clearly keep the fact in mind, that the whole mass of every muscle when exerted, is strung up as seen in Fig. 24.

264. Think then of the thousands of muscular movements required in jumping, running, dancing, or even any of our most ordinary physical efforts; and of the great length of time all this muscular machinery can be kept in rapid, unceasing action, without causing any painful degree

of exhaustion. The mind can scarcely comprehend a few of these motions, and a little of this power of endurance; and becomes almost bewildered in thinking of the ceaseless action of nerves, muscles, and mind, and of the continued stream of healthful blood from the heart, as from an exhaustless fountain, to sustain all parts in vigorous strength and freshness.

265. And then, again, in case this labour had not been performed, or exercise taken, think of the great efforts nature would have been called on to make in getting rid of all that superfluous matter from the blood, through her various secretory channels; or of the injury to health from its remaining in the system, instead of being worked into muscular, nervous, and other fibre, to give healthful vigour to the whole body. The universal desire in youth for joyous exercise, and the frequent involuntary stretching of the limbs in adults, are just so many monitory hints of nature's eagerness to shake off her lethargic burden, and give full play to the whole physical powers.

266. Great changes may be effected in the muscular system by long continued, judicious management, especially in youth. Those who desire to be strong or active, and live to a great age, should take a small quantity of the most nutritious kinds of food, lead regular lives, indulge very much in out-door exercise and athletic sports; and never eat, drink, or sleep to excess. Whenever it is necessary or desirable, to make any extraordinary efforts, either of a physical or mental kind, care should be used in giving tired nature time to recover something of her former vigour before again overtasking her energies.

267. We know that the shortest way to make an animal very fat, is to give it a large quantity of food, keep it perfectly quiet, and let it sleep much; but we should never treat a horse in this way. Very fat animals have little muscle in them, being sometimes unable to carry their own weight; and it is possible for man to feed himself, and lead a lazy life till he cannot walk; nor could he then try the experiments on his muscles, given in secs. 263 and 264. The muscles, in such cases, are soft, and much lighter

coloured than in a strong healthy body, and life often terminates in apoplexy. Fat is formed chiefly of carbonaceous matter, which oxygen will consume and partly convert into muscular fibre, the oxygen being only obtainable by exercise.

268. Thus experience and science both prove to us that strength cannot be attained by eating alone; and the effect of exercise even extends beyond our own physical bodies, for the mother's milk is affected very materially by it. If she be healthy and lives well, without taking sufficient exercise, the milk will abound with butter; though it will be greatly deficient in *casein*, the nitrogenized principle that affords nutriment to the muscles, &c.; or, in simpler words, it would make her lovely babe fat, but not strong; while, on the other hand, if she took a sufficiency of suitable exercise, the milk would abound with casein, and her infant would become strong, and be quite fat enough. Casein is very similar to, only much more soluble than albumen.

269. Muscular debility is often the precursor of serious and fatal illness; for if means are not taken to stay its progress, and restore the system to some degree of vigour, the most vitally important of all the muscles, the heart, will become affected; after which the body has the double misfortune of containing impure blood, and a feeble heart to distribute it through the arteries and capillary vessels. Perhaps none of the organs are more difficult to influence by medicine than the heart; we should, therefore, be extremely cautious to guard against all chance of its becoming diseased. If we always keep in mind the intimate union of nerves and muscles, as seen in Figs. 23 and 24, we shall never be surprised at the wonderful effect muscular debility exercises, in depressing the spirits, and causing the most distressing nervous symptoms.

270. Very serious consequences sometimes arise from neglecting to use, or by cramping the energies of some part of the muscular system; either from illness, lameness, tight lacing, extreme cold, or neglecting to take proper exercise, and keeping the body or limbs too much in one position. The less we use any muscle or tendon, the more soft and

weak it becomes; till, in time, it altogether ceases its natural action. This is more especially the case in youth, and the largest proportion of female deformities may be traced to improper training, and undue restraints being placed on youthful amusements, especially playful enjoyment of out-door exercise. There must be a joyous use made of the lungs, and all parts require bringing into full play. The more this is permitted to be done under nature's simple teaching the better.

271. To make this important matter more plain, suppose we take one case of deformity, which will be an example of all the rest; a crooked spine for instance. The spine has been shown, in sections 251 to 255, to consist of 24 different bones; and Figs. 17, 18, 19, 20, and 21, show

Fig. 25. Deformed Spine.

those bones to be rather curiously formed, having many points and angles on them. To each of those projections, one or more tendonous cords are firmly attached, which connect them to some muscle or muscles; and it is by means of these muscles and tendons that the body is kept in an erect, or any other position, and moved from one posture to another; as they work in pairs, pulling one against another, like two men sawing timber.

272. A deformed spine is caused by some of these tendons and muscles giving way, and their fellows out-pulling them. Fig. 25 represents a case of this kind, where the curvature is towards the right side, and almost every bone of the column is permanently thrown out of its natural position. Sometimes it bends outwards, or to the left side. In most instances it might be prevented with proper care, exercise, suitable diet, and surgical remedies. On the first appearance of any symptoms of this complaint, the spine ought to be carefully examined by a skilful surgeon; and such measures taken for restoring the natural action of the dorsal and lumbar muscles as he thinks best, and persevered in till the recovery is completely confirmed.

273. There are two facts which demonstrate the importance and necessity of muscular action so clearly, that, being within reach of the most limited experience, they ought always to be kept in mind. We see those who are much employed out of doors, transgress almost every other rule considered necessary for health, with so much impunity, as to pass through a long life with little or no illness; while those who neglect this rule to indulge in an easy, sedentary life, are continually suffering from one disorder or another, in spite of all their care, and the best medical aid they can procure. Four or five hours should be spent every day out of doors, or in such a way as to have fresh air, and be engaged in some employment or another, if we really desire to retain health.

274. It would be far more tedious than profitable, to give the names, and wade through a description of nearly 500 muscles in the human body that have been named by anatomists. This will be seen by referring to Fig. 26, in

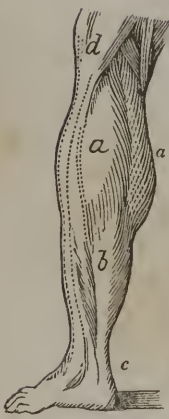


Fig. 26.

Fig. 27.

which *a a*, shows the muscles of the calf, called *gastrocnemius*, and *b*, the muscle *solæus;* connecting them to *c*, the *tendo achillis*, or tendon of Achilles. The tendons, *d d*, join the muscles of the calf to those of the thigh. One of the most important muscles of the arm, *biceps cubiti flexor*, is also shown in Fig. 27, to give a better idea of their form. The two tendonous, strap-like ends, *s s*, are firmly attached to the two upper points of the shoulder blade. The middle part, *u u*, swells considerably while exerting the arm in lifting, &c., (see also, *u*, in Fig. 15;) *v*, unites with other muscles of the fore-arm, to assist in binding the whole

together; and *x*, is the tendonous end attached to the upper part of the bone, *f*, in Fig. 15, called *radius*, being a chief agent in all the efforts that move the elbow joint.

275. A knowledge of the name and position of every muscle in the body, is not half so useful to the non-professional world as it is to be practically acquainted with the best way of gaining and retaining the greatest amount of muscular strength. Unfortunately, man is comparatively ignorant on this point. It is true, some little is known on the subject by a few who are employed in training men to fight or run! and also in training horses and dogs; but as man, generally, never consults a doctor except when he is unwell, the profession are led by custom and interest to study disease almost exclusively, as no one will pay them a fee to know how to obtain a high standard of health and strength, and how to retain it to a good old age. Nor would a mere medical man see, that doing this was his duty, or tended to promote his interest.

276. As man is now making considerable efforts to bring science to aid him, in getting a knowledge of the best means by which he can make money of his cattle, let us see how far the facts brought to light in these experiments, (and thrown away as dross,) may be employed in improving man's health and strength. Both comparative anatomy and physiology prove the propriety of doing this; and it is clearly shown, by experience and science, that the rules by which fat or strong muscle can be put on the bones of most of our domestic animals, and of man, are so nearly alike, that they may be safely adopted in either case; man, or animals. We must try to gain all the knowledge we can, on this important matter; and it is to be hoped man will, ere long, be induced by duty, policy, or profit, to institute an inquiry of the kind (difficult and expensive though it may be) for the good of himself, as well as for fattening his animals.

277. In the numerous experiments to ascertain the cheapest way of fattening cattle, sheep, &c., the general results prove, that the least quantity of food is required to fatten animals kept warm, two or three together, in total

darkness and quiet; though the flesh of such animals, from taking no exercise, is not so sweet to eat, or so nutritious when eaten, as would have been the case if a little exercise had been allowed in the open air—that animals reared on rich pastures require more and better food to fatten them than those animals that have been reared on poor pastures —and that the flesh of the latter is most sweet and nourishing. It is also found that the animals fattened in the shortest time and kept most quiet, have the least strength before they are killed; and their flesh has little muscle (lean flesh) in it, when cut up; and that old animals, or such as have been employed in labour, (an ox at the plough for instance,) are very difficult to fatten; their flesh, at the best, being very tough to eat. Fat is deposited between and upon the muscles, in cellular (cell-like) tissue, as may be seen well, in any cut joints of meat.

278. Experiments on milk-giving animals also prove several important results. More butter is found in milk when the animal is kept pretty quiet, than if much exercise be taken; but in the latter case, the milk contains most *casein*, the ingredient in milk which affords nutriment and strength to the muscles of those who take it as food. Excitement and irritation are found to reduce the quantity of butter, and otherwise injure the quality of the milk given afterwards, very materially. We thus see what makes fat and feebleness in domestic animals, as well as the way how to get milk from some of them to make ourselves either fat or strong. See also sec. 268.

279. With these facts clearly established by science as well as experience; and the additional fact, that any animal, however fat it may be, (if not become bloated and diseased,) may be made lean and strong again, by proper exercise, and its diet being reduced to a healthy quantity and quality; and that these rules and laws apply to man and beast alike; can it be any longer doubted, that our muscular strength and vigour is, to an almost unlimited extent, placed by our all-wise Creator under our own control; and depends mainly on the use, or abuse, we make of these benevolently designed and constantly operating

laws of our physical nature? Constitutions and temperaments, no doubt, differ considerably; some being far more susceptible of modification and improvement by enlightened care than others; but it is quite correct, in the absence of disease to say, as a general rule, man may be physically strong or weak, active or tardy, muscular or fat, healthy or unhealthy looking, according to his wishes or his tastes; if he knows and acts upon the laws on which these several states of body depend.

280. Little is yet known of the peculiar way in which nature effects these changes, under a careful obedience to the laws of our physical organization; though the most rational opinion is, that well-directed bodily exercise not only causes the digestive powers to extract from the food matter more suitable to be converted into muscle, tendon, and bone; but also converts a considerable portion of any super-abundant fat that may have been allowed to accumulate in the system, into fibre of greater strength and tenacity; through the agency of the increased quantity of oxygen introduced into the blood by exercise. Fat consists chiefly of carbon and water; exercise brings oxygen through the lungs to consume the carbon and evaporate the water in perspiration and other secretions; the carbon, as it is consumed, aiding in the formation of muscular and other fibre, or entering into the venous blood, to be discharged from the body. This may partly account for the amount of strength gained by resting a few minutes, when out of breath from any cause.

281. Setting aside, however, all speculation as to *how* these important changes are effected, and contenting ourselves with a practical knowledge of the means in our own power for effecting them, we may safely adopt the following as laws affecting our muscular strength, which is but another term for vigorous health. That a proper supply of wholesome food, drink, air, and refreshing sleep, with plenty of bodily exercise, especially in the open air, tend, more than any other means, to enlarge and strengthen the muscles, and increase their powers of enduring fatigue, provided the food is generally regulated in quantity and quality

to the amount of labour or exercise performed; the latter not being too exhausting or too long continued; and provided mental excitement and depression are avoided, all the skin kept clean, and alcoholic drinks not used.

282. It is equally certain we cannot indulge in eating, sleeping, or indolent habits, without gaining fat, and, at the same time, losing muscular strength; or in alcoholic drinks, without sowing the seeds of disease. Dirt on the skin chokes up the pores; and, by keeping bad matter in the blood, tends to make the muscles soft and flabby, unbrace the nerves, and, of course, depress and becloud the mind, and bad air greatly aggravates these evils. Taking little food, little exercise, and little air, entail great delicacy of constitution, by softening and enfeebling the muscular and nervous system; and one of the greatest barriers to our attaining a high standard of national health and physical strength, is found in the false and unnatural notions existing about female beauty—ideas, which amount to the absurdity, that the most certain way for a young and lovely woman to become a wife and a mother, is for her to destroy her constitution by producing such an unnatural delicacy of look and fragility of form as completely to unfit her, morally and physically, for fulfilling and sustaining the duties of those exalted and holy stations.

283. Before leaving this part of the subject to enter on a description of the abdominal organs, it will be as well to say a word about the *Diaphragm*, or midriff, *D D*, Fig. 30, an important muscular partition, firmly closing up the lower end of the chest so as to keep the heart and lungs completely separated from the stomach, liver, bowels, &c. It is securely fixed at the edges, to the spine, the short ribs, and the breast-bone; and the middle plays freely, rising as we expire air from the lungs, and falling to increase the capacity of the chest as they fill again. The power of this and the other muscles employed in drawing in the breath, is equal, in a strong, healthy man, to a force of about 4000 lb.; and, in expiring the air again, to 1000 lb. Little of this force is required in ordinary breathing, yet the constant action of these muscles being essential to life, we see what

ample provision is made to prevent their becoming tired. These muscles, together with those of the heart, and a few others, act independent of the will, which is called *involuntary muscular* action. The gullet, large blood-vessels, &c., pass through the diaphragm into the abdomen.

284. The LIVER is situated close under the diaphragm, in the right hypochondrium, its thinner edge covering the right side of the stomach; being suspended and kept in its place by several ligaments attached to the diaphragm, the breast-bone, and (by the *umbilical*) to the navel. It is of a dark, dusky brown colour, convex or round on its upper, and hollow on the inner surface; its front edge, lying over the stomach and bowels, is much thinner than the back part, and it is the largest gland in the body. *Glands* consist of an artery, vein, nerve, lymphatic vessel, and excretory duct, and their office is to secrete from the blood some fluid necessary for health or life; the peculiar use of this large gland (weighing in a middle-sized, healthy man about 3¾ lbs.) being to secrete, or extract from the blood, the *bile*, which plays so important a part in the process of making digested food into blood, as seen in Part First, Lesson VI.

285. To give a better idea of the internal structure of the liver, and the peculiar way in which bile is secreted, Fig. 28 represents nearly one-half of the veins composing it, on as large a scale as the page will allow. The venous blood from the bowels and stomach all flows into the liver: the veins from them uniting form the *vena porta*, *a a*, Fig. 28; which, on entering the liver, is seen branching off in all directions throughout the whole gland, to admit of a universal distribution of the venous blood through the liver for the more easy and effectual extraction of bile from it. At the innumerable twig-like extremities of these veins, *b b b b*, another equally numerous series of branches commence, to receive the venous blood after being purified of its bile. They are called *vena cava*, and continually unite and grow larger, till all join the *vena cava ascendens*, (see A, Fig. 3, sec. 86,) just before that great vein discharges its venous blood into the right auricle of the heart.

286. The blood moves much slower in the liver than in

most other parts of the body. In Fig. 29, the form of the liver is seen at *k k k*, the duct from it at *g*, the gall-bladder

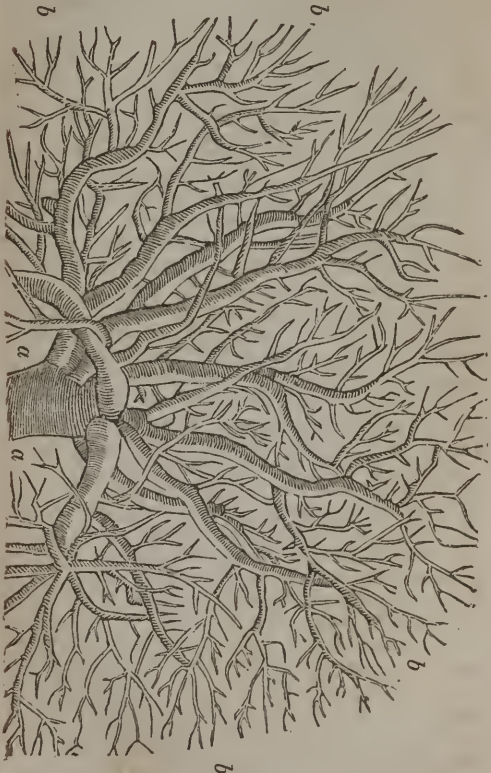


Fig. 29. Part of the Veins in the Liver.

for containing a due supply of bile to be ready for use at *f*; and *h*, is the common duct from both gall-bladder and liver, by which the bile passes into *e*, the duodenum to be mixed with the digested food or chyme. Sometimes a little of the bile enters the stomach through the pylorie valve, *d*, instead of all passing, as it ought to do, down the intestines. The liver is a most important organ, and to ensure our early attention to any obstruction or diseased action in it, a complicated net-work of nerves connect it with the other surrounding organs. This nervous complication is formed chiefly by ramifications from the *great sympathetic* nerve, which, proceeding from the fifth and sixth cerebral, and a branch from the eighth pair of nerves, passes down near the spine, distributing itself to all the organs of the chest and abdomen, in such a manner as to be able to convey to the brain notice of any obstruction or injury they may be suffering—especially if it be either the liver or stomach. Should the cause not be removed, the other organs, from their close and sensitive connection by this nerve, soon suffer also; and the result is, a fearful combination of mental and bodily disease, called *hypochondriasis*, from the name of the upper part of the abdomen where this net-work of nerves is situated.

287. The KIDNEYS are two large glandular bodies employed in extracting or filtering the saline secretions called urine, from the blood. They are nearly of the same form as a French bean, and are situated in the upper part of the loins, one on each side of the spine, protected by the two last ribs, and they usually weigh about six ounces each. The right kidney is under the liver, being rather lower than the left, which is under the spleen. At the hollow part in the middle, each kidney receives an artery, which, immediately on entering, branches off like the vena porta, in the liver, Fig. 28; and as the blood passes through the net-work of minute vessels, it leaves its superabundant salts, juices, and unnecessary fluids, which are afterwards conveyed to the urinary bladder, *i*, Fig. 30, at the bottom of the abdomen, by a tube from each kidney about a foot long, called *ureters*.

288. The Pancreas, or *sweet-bread*, is a large oblong gland, *n*, Fig. 29, situated behind the stomach; it secretes a juice similar to the saliva, which enters the duodenum through a short duct, *c*, Fig. 2, section 63, at the same place as the bile; and is mixed with the digested food to aid in extracting chyle from the chyme. The Spleen is another oblong gland of a depressed oval form, situated to the left of the pancreas, behind the stomach, in the left *hypochondrium*, close under the diaphragm, at *o*, Fig. 29, and is the colour of cast iron.

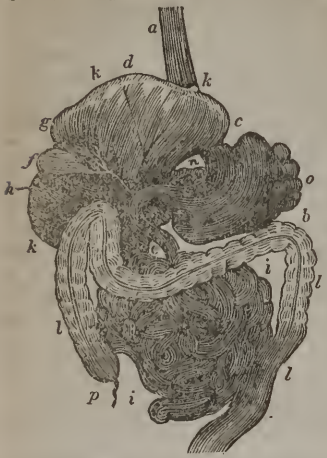


Fig 29. Digesting and secreting organs.

It is supposed to aid the stomach in secreting gastric juice; but having no perceivable duct, like most other glands, its use is not yet clearly known.

289. Lacteal Vessels are very small pellucid tubes, commencing with open mouths in vast numbers, from the jejunum and ileum, or small intestines, as seen at *f f f*, in Fig. 2, section 64; their office is to extract the chyle from the digested food or chyme, when they convey it along the mesentery through the mesenteric glands, and eventually into the receptacle of the chyle, as described in section 64. These vessels are very numerous, and are distributed over a great extent of the intestines, to afford means for more effectually absorbing the chyle, and preventing any nutriment contained in the digested food from being wasted, if it is wanted in the body.

290. The Bowels or *Intestines*, consist of an intricately winding tube, which commences at the right or pyloric orifice of the stomach; and they receive the digested food as it passes out of that organ, as seen at *d*, in Fig. 29. The first portion of the intestines (into which the bile and pancreatic juice enter to be mixed with the chyme) is called *duodenum*, *e*, Fig. 29; the second *jejunum*, from its being generally found empty; and the third, *ileum*, distinguished from the jejunum by its coats being rather thicker and more pale; and this terminates the small intestines, which which are of great length, and are folded in all directions, as seen at *i i*, Fig. 29, and *e e e*, Fig. 30, occupying a considerable space in the abdomen.

291. The *colon*, the first portion of the large intestines, is joined to the ileum in a curious manner; having a sort of dependent pouch, called *cacum*, at its commencement, as seen at *h*, Fig. 29; which lodges in the cavity of the right hip-bone. It will be seen by the engraving, this portion of the bowels is much larger in diameter than the small intestines, and its course is shorter, first ascending up over the right kidney, then crossing to the left, under the stomach, (it is here called the transverse arch of the colon, *C C*, Fig. 30,) it turns a little backward, and descending in a crooked form at *c*, Fig. 30, like the letter S, (called the *sigmoid flexure* of the colon,) terminates in the *rectum*, which is the last division of the intestines, and from its orifice the contents of the bowels all pass away. Through the chief course of the intestines, they are firmly attached to the mesentery, (*e e e*, Fig. 2, section 63,) which sustains all the arteries, veins, lacteals, nerves, &c., and being itself fixed to the loins, confines the whole mass in their proper places, to prevent them from becoming displaced or twisted. The bowels and kidneys form the most ready medium by which nature can throw away all the unnecessary matter we put in the stomach, when little or no exercise is taken.

292. The whole cavity of the abdomen or belly is lined by a smooth, tenacious membrane, called the *peritoneum*; which contains the bowels, mesentery, lacteals, stomach, liver, pancreas, spleen, and the *omentum*, or *caul*, a thin,

fatty, membranous net-work, descending from the stomach over the surface of the small intestines, and resembling in its form a tucked-up apron. The whole interior of the chest is also lined by a very smooth membrane called the *pleura*, and the *mediastinum* is a membrane dividing the chest into two nearly equal divisions; to prevent the two lobes of the lungs or the heart from incommoding each other when we lie on either side; and also protecting a healthy lobe of the lungs from being affected by any disorder in the other. The heart is enclosed in an exceedingly strong membrane, called the *pericardium*, or heart purse; which keeps that vital organ in its place, and prevents any friction from the lungs, or other interruption to its unceasing offices.

293. Lymph is a clear fluid, of a very pale red colour, (which will coagulate like blood, contains transparent globules, and circulates in a peculiar class of vessels, called *Lymphatics*, or absorbents,) distributed chiefly about the joints, and in the glandular and membranous parts of the body; those from the lower parts discharge their lymph into the receptacle of the chyle, and those from the upper join the thoracic duct, immediately before it discharges the chyle into the subclavian vein. These vessels are extremely minute, and in the groin, arm-pits, neck, &c., they are joined together or interwoven, so as to form numerous glands for aiding in the action of those parts, by affording moisture to the joints, and lubricating them. It is from the exterior mouths of these vessels that the sensible and insensible perspiration is exhaled from the body, and they also discharge much vapour into the air before it leaves the lungs.

294. To give a more clear idea of the various internal organs, the chest and abdomen are laid open in Fig. 30, and most of them exposed, in their natural position. Of the two orifices in the neck, *a*, is the *œsophagus*, or gullet, by which food and drink enter the stomach; and *b*, is the *trachea*, or windpipe, through which air is received into the lungs, *r*, being the right, and *l*, the left lobe of the lungs: *h*, is the heart, and V, is the aorta, or great artery, dividing

to send two main branches to the right, and two to the left, for supplying the arms, head, &c., with arterial blood. The heart, lungs, and blood-vessels fill the *thorax*, or chest, which is separated from the abdomen by the elastic muscular partition, D D, the *diaphragm*. Besides the stomach, there is the liver, the bowels, and *i*, the bladder, exposed in the abdomen; *e e e*, being the small intestines, C C, the transverse arch, and *c*, the sigmoid flexure of the colon, or large intestines.

295. Both internally and externally, each part of the

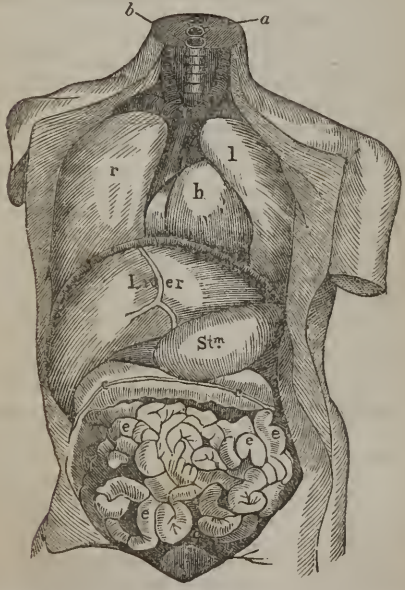


Fig. 30.—Organs of the chest and abdomen.

body, limbs, and organs, are covered by a membrane or SKIN, of various textures, strength, and colour; to knit their fibres firmly together, and protect them from injury. The external surface of the physical structure is covered by a compact, tenacious, elastic skin, formed of three separate layers; the outer coat called the *cuticle epidermis*, or scarf-skin, being thin, (except on the palms of the hand, soles of the feet, or other parts much used,) without colour, nerves, or arteries, and, of course, without blood and feeling. Under, and adhering to the cuticle, is the second or middle skin, called *rete mucosum*, (supposed by some to be double,) a soft, pulpy, and almost jelly-like membrane, in which is the colouring matter, giving the hue or complexion to the face and body; whether the fair white European, the yellow Asiatic, the black African, or the copper-coloured native American. There is no doubt this colour is caused, or greatly modified, by climate, temperature, &c.; and that its effects serve to mitigate very materially the scourging heat of the sun in some climes, and the severity and humidity of others.

296. Immediately beneath this very useful colouring matter is the *cutis*, or true skin; a closely interwoven fibrous membrane, much thicker than the two former skins; and so full of arteries and nerves, that the finest pointed needle cannot be pressed into it in any part, without drawing blood and causing pain. It is the cutis, or true skin of sheep, cattle, &c., that, by currying, tanning, and dressing, is made into leather. Under the true skin in almost every part of the body is a cushion of fat formed of the *membrana adiposa;* a sort of net-work full of cells, that give a plump, sleek appearance to the body when they are well filled with fat; or of painfully apparent emaciation when all the fat is absorbed by disease or other causes. *Hair* grows out of the true skin, from bulbous roots, which supply each hair with constant nourishment; and, in health, give it an oily gloss. Every hair is a hollow tube. *Nails*, though of a different form, are very similar in their nature, and the matter of which they are composed, to hair; both being insensible to the touch, and continuing to grow during life. One serves as a beautiful ornament to the

head, the other as a strong defence to the ends of the fingers and toes.

297. The SECRETIONS thrown away by nature as no longer needed in the body, deserve much of our attention; as an excess or deficiency in any of these cannot continue long without serious harm. The bowels may be said to discharge the largest and most offensive quantity of the secreted matter from the body, and inattention to nature's wants, in this respect, will inevitably produce immediate or remote injury to health; modified, of course, by constitution, nature of employment, age, and other causes. This is the main channel by which the stomach and liver get rid of their offal matter, as well as several other glandular bodies, and the blood generally; and being the common receptacle for whatever may be hurtful to the animal economy, ought to be emptied daily. The *Bile*, a yellow, ropy fluid, secreted by the liver, aids materially in the process of making blood from the food; and a great portion of it, consisting of yellow, bitter, resinous matter, passes out of the system with the other gross secretions or excretions through the bowels; generally giving to the whole mass a bright brown colour in health. The intestines continually urge their offensive contents forward, by the *peristaltic* or worm-like action of their coats.

298. Fluid secretions are made from the blood by the kindeys, which filter a large quantity of saline matter, a peculiar crystallizable ingredient called *urea*, and a considerable portion of water, which all drop through the uterus into the bladder and thence pass out of the system. *Perspiration* is very similar to the watery portion of the urine, and the quantity of one diminishes or increases the quantity of the other. Both sensible and insensible perspiration are discharged from the lymphathics and glands, through the skin; to keep the surface and also the internal parts of the body from becoming too much heated by action. A slight glow of insensible perspiration escapes from all parts of the skin at all times, if not obstructed by dirt, too much cold, or disease; as may be seen by applying a bright piece of metal or glass to any part of the skin. The salivary glands

also secrete saliva, for mixing with the food; the stomach secretes the gastric juice for digestion; and the pancreas adds another salivary secretion to the digested food as it enters the intestines. The broken ends of a bone also secrete bony matter to aid in joining them again. *Mucus* is secreted by the lungs and brain to keep them clear, and in a healthy state. Exercise is, of all things, the most promotive of a due discharge from each of the secreting organs; and, what is the same thing by another name, most promotive of good health and long life, if the body is duly fed, clothed, &c.

299. Hunger may be called nature's warning voice, to tell us the stomach is quite empty, and unable to satisfy the demands still made upon it; and, if this call is not, from any cause, attended to, harm is done, to a less or greater extent, according to the state of the body, the exertions made, the time the stomach is kept empty, &c. Few are unacquainted with the first sensation of hunger, which may rather be called a good or keen appetite for food. This is soon succeeded by a dull, dragging pain—contractions of the stomach—increased secretion of mucus—evolution of gases, followed by general feebleness and exhaustion; the symptoms becoming more severe and insupportable, till the stomach is unfit to receive food, and death ultimately comes to relieve the sufferer. In a healthy state of the body, hunger is induced or increased by exercise, cool air, and a tranquil or moderately excited mind; while, on the contrary, a sedentary life, heat, great mental excitement, and especially derangements of the stomach, liver, or bowels, enfeeble, injure, or destroy the appetite. Meals ought to be taken regularly, both as to time, quantity, and quality; the two last depending on age, constitution, and employment; and five or six hours is quite long enough to go without food, as longer fasting is generally followed by eating too much. Invalids should observe all these rules very strictly, if they desire to get well again.

300. Thirst shows a want of liquid, as hunger indicates a call for solid sustenance. The dryness of the mouth and throat, and the succeeding sensation of burning heat, need

not to be described, as the beginnings of thirst. These, if not attended to, increase, and produce similar, though far more intense sufferings than extreme hunger. Natural thirst is best and most effectually allayed, by pure water; the parched sensation of unnatural thirst, caused by the use of alcoholic drinks, cannot be long subdued by any thing but abstinence from that which caused it. Much liquid of any kind induces thirst, and is sure to derange and weaken the system, which is very evident in the small feeble race of labourers found in districts where cider abounds, who often drink two or three gallons of cider in a day during harvest. Natural thirst is evidently caused by want of moisture in the stomach; as it can be appeased without wetting the mouth or throat, if water be poured into the stomach through an artificial tube, or even by immersing the body in water. Thirst may also be much diminished by chewing some hard substance, even a pebble; as this excites a discharge from the salivary glands.

301. Sleep is as necessary for the renovation and healthful repose of the nervous system, and the mind, as food and drink are for the muscles, bones, and other parts of the body. Rest alone, unaccompanied by the oblivial state of insensibility called sleep, will not restore the lost vigour occasioned by long-continued waking efforts. At the close of a laborious day the muscles relax, and become languid —the eyes grow dim and heavy, the blood flows lazily through the lungs; followed by yawns, nods of the head, (if not supported,) external objects cease to attract, and the mind becomes feeble—confused—oblivious. We are not sensible of reaching the last stage, though sometimes convulsively recalled, just as we reach it, by the sudden rushing in again of the active mental powers. The healthful sons of industry find their lot freely and liberally softened by the balmy repose of sound sleep, though the children of luxurious ease often complain that they are not treated in like manner.

302. Sleep, like the taking of food, should be regular; too little causes languor and exhaustion in time, and too much produces heavy, benumbing influences on both body

and mind. The quantity necessary for health is greatest in childhood; in the prime of life, seven or eight hours, even after a day of hard labour, is quite sufficient; though, in old age, a little more is required. Sleep in the day should be avoided. The most certain promotives of profound healthy repose are labour, mental peace, a temperate and wholesome supply of food, clothing, and drink; and a properly ventilated sleeping-room. If few dreams are desired, and those few pleasant ones, the body should be laid at perfect ease on one side, the limbs not pressing or incommoding each other, the hands open, the stomach not full, and the head moderately elevated. Digestion goes on more slowly during sleep; the heart beats with less vigour, respiration is more deep and slow, and the various secretions are rather less rapid than at other times. Early repose is far more refreshing than if deferred till midnight or later. Much dreaming indicates imperfect, or too long-continued sleep; though a loaded stomach, or a deeply-harassed mind, will often produce that effect.

303. Temperaments form the peculiar and distinctive combination of physical and mental character met with among mankind. They are seldom found pure in mixed society; but a knowledge of the distinguishing traits in each of the four classes will afford the best means of perceiving which temperament predominates in any individual. The *phlegmatic* or *lymphatic* temperament appears to be the least intellectual. Its external indications are a very pale, white, soft, and hairless skin—fair, and thin hair—tame, placid, or flabby features—flesh very soft, mostly inclined to corpulency—weak muscles, all the vital actions in the system languid, and the physical and mental functions slow and feeble; with an almost insurmountable dislike of all kinds of exertion. Few pure specimens of this class exist, if we except habitual invalids and females past the middle age, who, by spending a totally inactive life, have lost all the energetic tendencies of their original constitution.

304. *Sanguine* temperaments are known by the animated, often florid countenance—plump, firm muscle—light or chestnut hair, blue eyes, a full, frequent pulse, and very

active circulation of the blood. Persons of a sanguine exhibit far greater energy and decision of character than those of a phlegmatic temperament; but they are soon affected by the trying or pleasing scenes of life; exhibiting a strong disposition to enjoy the present, regardless of the future. The distinguishing marks of the *bilious* temperament consist in dark or black hair and eyes—yellow or brown skin—not very large, but full, firm muscles, with no tendency to corpulency; the countenance exhibits great firmness, decision, and sometimes harshness of expression; and they generally manifest great activity and energy, both of body and mind, and are not easily discouraged or subdued. *Nervous* temperaments generally show great delicacy of form and constitutional sensibility—they have fine, thin, and frequently curly hair—a quick eye, small and rapidly moving muscles, sensations very lively, and little inclined for mere animal gratifications. Their nervous system greatly preponderates, and their mind passes from one subject to another with the utmost facility. The nervous and phlegmatic tendency of constitutional temperaments may be greatly improved in healthful vigour, by a course of judicious training. It is often impossible to decide which temperament predominates, except by a close comparison with other individuals.

305. Animal Heat, or the property man and many other animals possess, of remaining at nearly the same temperature at all times, has excited much attention. Water will freeze at a temperature of 32 and boil at 212 degrees; yet man's body, while living, would alter very little from 98 degrees, its natural heat, in a situation where water freezes or boils. Sir C. Blagden stayed in a room heated to 264 degrees, while his body was not heated to more than 102 degrees, though he breathed air that roasted beef and eggs. The most that is yet known about this wonderful power of repelling or retaining heat is, that some way or other it is caused by the action of the air on the blood in the lungs—the generation of carbonic acid in the blood, during its circulation, especially through the capillary vessels—and the modifying influences of the nervous

system. The practical effect of this benevolent law of man's nature is to enable him to live, with comparative comfort, in all climates, seasons, and temperatures, if he adapt his clothing, food, &c., to his situation; which last privilege he enjoys alone, as other animals cannot change their clothing when they like, as he can, and seldom their food and shelter. Cold does far more injury to the body than heat, as it obstructs the circulation of the blood. Great care should therefore be taken to protect the body from external cold by good warm clothing; that next the skin ought to be fleecy and of loose texture to retain the animal heat. In very hot weather, light-coloured and easy-fitting clothes are the best for keeping the body cool.

306. The Sexes are a universally distinguishing feature throughout animated nature, more especially among the human race. Man appears, in all ages, to have been physically larger and stronger than woman, whose power chiefly consists in tenderness, sympathy, and affection; and these being under-valued in savage life, woman never attains her proper, exalted, and useful station, till society becomes civilized. Man has generally a large square chest, most capacious at the shoulders, large bones, with strong, firmly-knit joints and muscles, especially on the arms and legs, and close firm skin, with strong crisp hair. While woman is more delicately formed, her bones are small, hips broad, shoulders narrow but graceful, muscles soft, plump, and beautifully moulded into each other; the skin soft and delicately smooth, the hair silky, and the eye lively and full of the most tenderly captivating emotions.

307. Man commands by a dignity of mien, and firmness of deportment; while woman subdues or disarms by submissive gentleness, kindly sympathy, or virtuous loveliness. Neither sex appear to enjoy the same liveliness of disposition when alone, as in each other's society; and there is a nameless charm even in seeing each other, that seldom fails to cheer the most gloomy and misanthropical, though they should not so much as know each other's language. Human will and reason are as passively powerless in every thing connected with this natural law of the affections, as

in all things relating to the physical law which regulates the proportionate number of the sexes; and yet both laws operate so universally, in all ages and countries, that the benevolent wisdom of our Creator has left nothing for his creatures to do in these matters, but gratefully to enjoy, in childlike simplicity and virtue, the delight-giving fruits of his Fatherly care and goodness!

308. Woman furnishes the strongest barrier against returning barbarism, by her enlightened, virtuous attachment —pure morals—devotional feelings; and the holy influences which she throws so charmingly around infancy and childhood are so powerful, that nothing can afterwards fully obliterate them. Surely these form a sufficient return for the mere act of justice which civilization confers upon her, in exalting her from a false and degrading position to her true and natural sphere; in which she often becomes, and is always capable of becoming

"A ministering angel"

to suffering humanity. With a powerful mind, prone to deep thought or great resolves, and of an adventurous, daring spirit, man is too apt to sink under the withering blights of adversity; while the apparently delicately tender plant, that has been trained to wind round his stronger nature, and gently lean on him for support, is sometimes seen to bend to the devastating storm, and then, rising above it, in the majesty of womanly fortitude, collect the scattered elements of former grandeur; and, by the aid of endearing sympathies and talents before concealed, convert these fragments into more than former happiness.

309. Emotions *of the mind* have a wonderful effect for good or ill, on the physical and mental powers. Though the brain is the organ of mind, these its actions, called emotions, *affections* or *passions*, are generally felt at the heart; as that organ has, in these cases, a sudden and considerable demand made on it, to supply the necessary quantity of blood to the brain, that it may sustain the required efforts without injury. In ordinary cases the same sensations are not felt, as the mind then labours steadily and the

flow of blood is consequently regular; and this may be large without any great excitement being felt, just as regular labour, though hard, does not produce the same sensations and feelings that a sudden excessive effort does.

310. *Hope, joy, delight,* and *love* produce an agreeable and salutary action of the heart and other organs; increase the circulation, improve the appetite and health, often aid greatly in removing disease, and always render life more pleasing. *Anger* stirs up both physical and mental powers violently; especially when it increases to *rage;* the heart beats with hurried rapidity, the blood is forced into the capillary vessels with such force as sometimes to burst them; the secretion of bile is increased, and the muscles are for the time firm and strong. Excessive *terror* often produces nearly similar results. *Fear, grief, melancholy, despondency,* and *despair* retard the action of the heart, enfeeble the nervous and muscular system—often derange the digestive process and the bowels—interrupt or suppress the glandular secretions—and if continued, originate severe and fatal diseases. Shame seems to stop the blood in the capillaries of the face. Many of these emotions or passions produce fatal results or destroy mental sanity, in extreme cases; particularly where great weakness previously existed.

311. Man's *physical existence* may be divided into three stages, *infancy, maturity,* and *old age.* When ushered into life, he enters on an independent existence in a far more helpless state than other animals; many of them being able to walk, and have sufficient instinct to find their food immediately on attaining life; while a child would die, if left to itself till it is several years old; not being able so much as to walk alone during the first ten or twelve months; and it advances to maturity by a very slow process, though its organization is much superior to that of any other animal. The food of infants should be simple and nourishing, (see sections 230 and 268,) they ought to sleep much, and by all means to be kept dry, and have all their skin washed in tepid water, with soap on a piece of flannel or sponge, at least every morning and evening; being afterwards wiped nice and dry, and allowed to kick

and stretch their limbs a little before dressing. A child used to being clean and dry, will immediately show signs before it can talk, when cleaning is required. In health, children should rather be encouraged than restrained in exercise, both of body and mind; even infants ought to be carried out in the natural air an hour or two daily, weather permitting.

312. *Maturity*, or full growth, is reached by females in many tropical regions, by the tenth or twelfth year, and males, by the time they are fourteen; though in our country, manhood is generally attained from the age of sixteen to twenty; and womanhood from fourteen to eighteen; after which the body and limbs increase in bulk and strength for several years. In all ages and countries the sexes have always been nearly equal in number. About twenty males are born for nineteen females; but the greater difficulty of rearing boys, and the various risks to which male life is subject, reduce the number of men, generally, below that of women, though this is so trifling in Great Britain, that among the 8,602,647 persons, under twenty years of age, there is only 485 more females than males, being about one in every 17,737. The duration of healthful, vigorous maturity, depends on constitution, climate, and mode of life, especially the last. Generally, the greatest strength is enjoyed between the ages of thirty and fifty, after which

313. *Old age* evidently comes on apace. Should the laws of physical health, previously explained, have been duly observed during infancy, youth, and man and womanhood; few outward symptoms of decline may be visible at the age of fifty, but generally, about this period our decreased strength, activity, and powers of endurance, tell us plainly, the most stirring and busy scenes of life are past, and that our future means of usefulness must depend more on knowledge, wisdom, and prudence. As the body wears out, the bones become brittle, the muscles and tendons stiff, and the nerves, and consequently the mind and senses, less sensitive; the moisture and secreted humours become vitiated and diminished, and the blood flows much more slowly, and is far less capable of replenishing the noble

structure it has so long sustained, than it was "in days that are passed." The food ought to be nourishing, exercise should not be neglected, nor should cheering society, especially that of children or youth. The harvest of life reaped in old age, depends chiefly on the manner in which that life has been spent; physical suffering punishing physical transgressions, or joyous peace and health rewarding constant obedience, till at length the animal frame gradually sinks, and again moulders into its primitive elements, and the liberated spirit is bid to "return to the God who gave it."

314. *Death*, sooner or later, comes upon all men. If our physical laws have been neglected or disobeyed, it may come early, to stop further transgression and suffering. It may seem hard for us to suffer disease and early death, not only for our own physical errors, but also those of our parents; yet there is much benevolence in this seeming hardship, of "visiting the iniquities of the fathers upon the children, unto the third and fourth generation of them that hate" God; as this law tends to arrest the spread of evil which might, if not thus checked, destroy all human happiness, or even extinguish the whole family of man. No diseased individual, family, tribe, nation, or race, can long continue to transgress God's laws, without meeting inevitable destruction; but he encourages to well doing by saying, "I will show mercy unto thousands of them that love me, and keep my commandments;" so that blessings are *not confined* to the "third and fourth generation." The good man endures disease, under the consolation that He who inflicts it always punishes with the least possible amount of severity; and calmly awaits death, not as "the king of terrors," but as a messenger from the Giver of life, come to "dissolve" the "earthly house of this tabernacle," making room for others on our limited stage of existence, to be ushered into a boundless eternity of bliss, and hear the glad tidings, "Well done, thou good and faithful servant, enter thou into the joy of thy Lord."

315. Conclusion.—We have thus seen the wonderfully mysterious organism, sense, and intellect, with which

our Creator, in his wisdom and benevolence, has seen fit to endow us; and the laws by which these earthly blessings are for a time continued. Every thing seems made for the express purpose of placing within our reach the greatest amount of happiness we are capable of enjoying in this preparatory stage of existence; the terms on which these blessings are bestowed being plain, simple, and universally adapted to all conditions of men, in all climes and seasons.

Unfortunately, however, these terms are, through ignorance, carelessness, or folly, often rejected; for delusive phantoms, that have filled, and still continue to fill, the world, with physical suffering—mental debasement—and spiritual apathy. To say God is not pleased with *all* man's efforts for mitigating or eradicating these evils, would be to assert that He who created life, and endowed man with sense, intellect, and spirit, and made all other things with the most clear and never-failing tendencies to promote happiness, desires general, if not universal, ignorance, disobedience, and disease; or an entire extinction of life. Avoiding such absurd, repulsive, and wicked fatalisms, let us strive with all the powers and capabilities God has given us, to obtain a full and clear knowledge of his laws; and render such a dutiful obedience to them, physically, morally, and spiritually, during our whole lives, as to prove to the world, that whatever others do, "we will serve the Lord;" that we may fully enjoy all the blessings he so richly offers; and that we may, at length, "die the death of the righteous," and our "last end be like his."

TO TEACHERS.

316. When you really desire to do any thing well, it is necessary, above all things, for you to know your true position; and the means you have, or can bring to your aid, in effecting the desired object. This knowledge will, no doubt, show many difficulties to be in your way; but if you face them firmly, and in a right spirit, you will find, in the end, this is far better than sailing through unknown seas without compass or pilot.

317. Your greatest difficulty will, most likely, arise from the nature of the material on which you are called to operate—mind, in all its infinite variety of forms. You cannot, as in most other employments, work to any given line or pattern; or by any measure or weight; but have frequently to be guided by your own judgment, with little on which you can rely, to form this correctly.

318. While you teach such things as writing, mathematics, and demonstrative science, and even correct reading, you have some tangible ground on which to rest, and mark the progress made; but in the instructions you give, with a design to fix in the mind right principles and opinions, for the purpose of moulding the character and influencing the conduct in life, you have to wait long before you see the effects of your anxious labours. Indeed, you feel glad if you ever see their results.

319. In these, the most important departments of your duty, you will too often find, that as fast as you build up, somebody else (over whom you have no control) pulls down. Their vicious practical lessons cancel all your virtuous theoretical teaching. Sometimes this is the case, without your ever discovering it to be so; and when you do find out such instances, you feel so powerless for good as almost to cause despair; unless you are well grounded

in right principles, and have unlimited faith in them, and their great Creator.

320. For these and various other reasons, the laws, facts, and principles of our physical nature, developed in "*Health made Easy*," are thrown, as much as possible, into the demonstrative form, in plain, simple language. We know very little how far any lesson is understood, and much less of the extent of conviction produced thereby on the reasoning faculties, by its being repeated, ever so well, without book; therefore, the following very copious Catechism has been carefully constructed, with a view to help Teachers in drawing out each individual fact from the minds of the learners. This should be done in such a way as to stamp them all in the most enduring form on the reasoning and judging faculties, as principles and laws which we cannot *evade;* and which it is *our* present highest interest to obey, whatever *others* may do.

321. There is far more mental labour, both to teacher and learner, in this mode of examination, than in merely listening to, or repeating a task. The latter plan is also considered to give the appearance of greater cleverness to youth, and is sanctioned by long usage in our old seats of learning; yet its having been adopted in an age when mind was far less understood than at present, ought to make us suspect that some change is necessary. We should not continue to light our streets with the dull flickering lamp, in an age when, and a country where, gas is known and much used.

322. Memory is only *one*, of the many powers of the mind that require the training culture of the teacher; and may be brought to a high state of perfection, independent of the other faculties, and without producing influence on life and conduct. Reason and modern experience show it to be most usefully cultivated, in close connection with the knowing, reflective, and reasoning powers; as a faithful and systematic registrar of their various acquisitions.

323. Knowledge is most useful to its possessor, when it is stored up in the mind by memory, in such a manner that each fact can be drawn forth at pleasure; and instantly

used, either with or without any other fact or facts, in the train with which it may be associated. An axe is very useful in felling a tree, but there are other means of getting trees down: a skilful workman can do many things with an axe besides cutting down a forest, and this is only one out of many instruments he uses in his trade. So with useful knowledge.

324. The Lessons, in the first part of "*Health made Easy,*" will be found to excite a peculiar interest in the minds of learners, because they will soon perceive their vast importance to themselves *now*, as well as during their future lives. In using the Catechism, to help them in fixing clear ideas of the physical laws of our nature in their minds, it will seldom be found necessary to ask all the questions, for two or three will sometimes be answered at once; and answers will frequently be given in such a way as to require the next question to be a little modified. The best plan is to have the whole class up, when they have sufficiently studied a given portion; and on any question being asked, each student prepared to answer it should put forth the right hand, when the teacher can select some one from the number; but, if the answer given is not satisfactory, a second or a third student may afterwards be called upon, for their answer. If this is sometimes done before the rest of the school, many will be inclined to listen, and much good be done thereby, as *all* are equally interested in the subject of bodily Health.

TO SELF-TEACHERS.

325. Those who seriously desire to supply the defects of their early education on this subject, cannot do so by reading a book over, and then considering it "as a tale that is told." When they have finished reading this book, they ought to begin again at Lesson first; and before leaving that, or any of the succeeding lessons, they should write

answers to each question on them in the Catechism; and till this can be done correctly, without referring to the text for aid, (supposing, of course, the self-teacher can write,) no lesson should be considered finished, or sufficiently learned. The necessity for all this will be obvious, if we reflect a little on the nature of the subject, its importance to ourselves, and the great difficulty of so changing our habits, when our youthful days are past, as to adopt the principles here taught.

326. Independent of the great Bible truth and Christian principle, that the laws of nature are God's laws, (if any sane mind should, unfortunately for itself, be so destitute of knowledge, sense, reason, or duty, as not to be influenced by such religious views of their organization,) our own ease, comfort, health, and happiness, depend very materially on our practical acquaintance with the subject, and our observance of the rules and laws it teaches. If we have a clear and correct knowledge of the peculiar temperament and constitution we inherit from our parents, we may gradually effect a very material mitigation of any diseased tendencies, or even eradicate them, and strengthen all the weak points by early and constantly obeying the laws of our physical nature; and eventually may attain vigorous health, and keep it to a good old age, instead of being, as might otherwise be the case, feeble and sickly, during a few years of an unenjoyed life.

327. The great secret of being able to do this well, lies in man having a right and clear view of his physical and mental state, by nature. All that first surrounds and acts upon his pure, spotless, heaven-born spirit, "is of the earth, earthy," to say nothing of more subtile and unfriendly agencies; and their influences are alien to his eternal peace, while they are flattering him with promises, never to be fulfilled, of present happiness. Man is, during several of his earliest years, a mere passive being, under these adverse circumstances; and should he be left to move on in the path of life from his own impulses, he would at this period be more likely to go wrong than right; not, as yet, knowing how "to refuse the evil, and to choose the good."

328. The most specious, alluring, and universally deceptive of all the fallacies that draw man from the path of duty, is that offspring of vanity and pride, in his own carnal mind, which is so constantly flattering him, especially in youthful ignorance, by saying, "Cannot *I* do as I like?" "To be sure I can," replies vain self-will. "See with how much ease and pleasure I did that and the other good thing, (we try to conceal from ourselves the motive which led us to do any good, if that motive be a selfish one,) and can do it again whenever I please; but surely, one ought to have a little enjoyment of life sometime. There can be no harm in such and such a thing, it is so *very innocent*, or it can injure my health so very little; and I am certain, the bare idea of going so far as such-a-body completely shocks me! Oh, no! *I* can stop just at *this* point, or sooner, if *I like*."

329. Now this is a rule so absolutely contrary to man's nature, that no human being ever did—does—or can—of himself, act upon it; and where the miraculous power of Divine grace enables some men, in a measure, to appear to act upon it, the many thorns planted in their fleshly nature by previous bad habits destroy most of their earthly enjoyment. No, no, vain man, with all thy boasted powers, thou wilt never do this, while the effects of thy fall in Eden trammel thy spiritual tendencies; for if this were now possible, it is doubtful if thou couldest, by such means, increase thy earthly happiness. Very little reflection is necessary to convince any one, that he does not possess this power over himself, if a small portion of honesty is used in self-examination. Let us, however, see, if the nature of things is not such as to make it utterly impossible for man ever to attain this power.

330. It is universally admitted that in many departments of skilled labour, and especially in most of the professions, all engaged in them do, or may, continue learning, and improving their skill and dexterity, during a long life. Superior activity, skill, and taste, are not the result of a *bare knowledge* of facts, styles, or principles; they are attained by constant study, and a thorough *love*

of the whole subject, (whatever it may be,) combined with long practice, not only of the hand, but the ears, eyes, and mind must be engaged in the work, if eminence in the particular calling be desired. Reason and experience prove this never can be done in a few short months, or by a little occasional study and practice; for in that time and way, the mind could not be trained to conceive—the senses to guide—or the hands to execute—the endless variety of thoughts, reasons, and actions, which need combining together, before any one can justly be said to excel.

331. This is more especially the case with common life; and to act our part well, in any, even the humblest station, much knowledge, united with great mental and bodily activity, is necessary. Nor is this all; our mind, if not trained to move in a right direction, may only be active in doing wrong to ourselves or others. A bad mind is constantly employed in gratifying itself; it sees no "sermons in stones," or good in any thing; every thing being seen, heard, and felt, through a depraved, unnatural medium. Perhaps it may be said with more truth of the mind—its various powers and faculties—than of the hands, that "practice makes perfect," either for good or evil. Hands, and mind, turn most easily, yea, involuntarily, the way they have been most bent; and it is sometimes almost impossible to get them into any other way, however much better it may be.

332. A serious error is committed by those who fancy it is quite sufficient if they guard against contracting vicious habits of thinking or acting. Success in life does not depend on our merely avoiding to do wrong, but also, on our doing right, and *always* doing right. Such habits cannot be acquired, without thinking right, and that must be based on correct knowledge. The fruits of knowledge grow from its being thoroughly engrafted into the mind, and so completely interwoven with all its passions and feelings as to form a predominant spring of thought and action; giving an instinctive perception, under all the trying and varied scenes of life, what is *best* to be done, and *when*, and *how*, to do it. As a general rule, this can only be done in pro-

portion as our knowledge is extensive, correct, and readily available, from its constant use, for the active business of real life.

333. Compare, for a moment, the immediate, vigorous, cheerful action, of an enlightened mind, long used to depend on its own resources in all cases; with the apathy, hesitancy, or feeble and unsuccessful efforts, under the same circumstances, of the ignorant, the misinformed, or those who have been unwisely trained to depend on other minds to help and guide them. Think how differently the slothful and the industrious view a scene in which they may act a part if they will; or, contrast the debasing passions of a vicious, with the ennobling, virtuous emotions of a good man, on viewing the very same lovely object at the same time and place. Indeed, every common occurrence of life furnishes abundant and conclusive proof, that most of our success depends on our own knowledge, or on its application; and most of our earthly happiness is the result of this being joined with a healthy body and a virtuous mind.

334. To illustrate these facts and views still further, and to prove how reciprocally each part of our compound nature constantly acts on the other at all times; let us take four practical cases, falling within the range of those who have even a limited experience of the effects resulting from a neglect, or disregard of the physical and mental laws of our nature. When the body is overworked, and the mind little cultivated or used, we generally find the feelings, passions, and manners partaking most of the animal nature—if they are not also low, indelicate, or base; and when, on the contrary, the mind is overworked, and the body little exercised—mental excitement, irritability, physical weakness, or even disease is the consequence. Should body and mind both be exerted too much, the health and constitution soon give way; and if neither are sufficiently developed or exercised, the highest enjoyment that can be attained is a mere passive existence, during a short life, often diseased, and always useless. Can we still neglect the laws of Health?

TO PUBLIC MEN.

335. FAR too little practical knowledge exists in the minds of public men, as to the best means for attaining health and long life; and the little they do know, makes them liable to commit great errors in their social and legislative efforts to do public or national good, and, consequently, they meet with great disappointments. The striking contrast between the healthful, enlightened, and joyous amusements and recreations of the useful classes in most continental towns, and the unhealthy, sensual, immoral, and vicious pastimes and entertainments, unfortunately prevailing among similar classes in our own country, have long excited public notice; and a really laudable desire now exists, to diminish, or, if possible, to remove so discreditable an evil.

336. Difficulties, however, stand in the way of attaining so desirable an end, which do not appear to be seen, or duly estimated, by those who take the lead in trying to accomplish such a noble purpose. Man has no power to command man, in the matter of spending his leisure hours; so that in this case we must do, what we ought to do in most others, draw by the silken cords of love, or lead by the ties of enlightened duty; and not try to *drive* people the way we want them to go, or vex ourselves, because they seem unwilling to let us do them good, in our own particular way. Though the physical and moral barriers to be removed are great; yet, if we clearly understand them, they may, in time, be overcome, by employing judicious means. If we look at the contagious nature of some diseases, self-preservation, as well as enlightened benevolence, will prompt us to adopt all the sanitory means in our power, for promoting public health; by inculcating habits of universal obedience to the physical laws of our nature. Both disease in the body, and vice or crime in the mind, spread with fatal rapidity, if not duly suppressed by wise

precautionary measures; and ultimately, the obedient suffer with the disobedient, to a less or greater extent, when filth or famine send forth pestilence, and when ignorance or passion deluge a country with war.

337. Much of the difference in the amusements pursued here, and abroad, arises from the peculiar position of the people. In Britain, labour, both of body and mind, is excessive; but it is far better rewarded than in most other countries. In our large towns, the industrious classes toil hard, get plenty of money, but improve their minds very little; often gratifying their appetites, and spending their leisure hours (or more) in the excitement, sensuality, or vice of the tavern, always near at hand, in preference to toiling an already exhausted body by walking, to enjoy the pure air, and the green fields which are distant; though it does cost nothing to obtain these healthful pleasures, but the walk to and from such open grounds as are still accessible to the public.

338. German, French, Swiss, or Austrian useful classes, are in a very different position. Their labour is seldom so exhausting, or so well paid; and having little money to spend in vicious indulgencies, and generally a public promenade open to them with frequent music free of expense, at no great distance; the humblest artisan, finding he is not too tired, takes a walk after his labours to inhale the fresh breeze; unloading himself of the accumulated carbon, and drinking in streams of life-giving oxygen, till his mind becomes oblivious of care, and his physical energies are renovated in nature's best and simplest manner. In this way, public custom gives a trait to national character, and the people train themselves into salutary habits, that mitigate, in a great measure, the evils almost inseparable from living in large and closely built towns, whose sites were not selected for their healthy, so much as their money-making advantages.

339. Another hinderance to out-door exercise in Great Britain is, the general and increasing taste for reading; as that gives rest to the body, while it instructs, interests, or amuses the mind. This is, no doubt, one great cause

of the solid sense, and utilitarian spirit, so prevalent among the people; and whenever they turn these sterling qualities seriously to the subject of their own health, strength, and physical comfort, the next generation will furnish superior specimens of humanity, and a far higher standard of national health than has yet been attained by any preceding race of people. Many circumstances seem to indicate the approaching advent of this joyous period. Considerable efforts have been lately made by the wealthy, and also by the great body of the people themselves, in some of our largest towns, to obtain free public gardens, parks, or promenades, in which the inhabitants might indulge in out-door recreation. Hitherto, unfortunately, these efforts have failed in attaining their chief object; for the mass of the people can only indulge on holidays in the healthful pleasures thus provided for them, as a daily walk of three or four miles can never be repaid to a tired body, by inhaling, for half an hour, the purest and best air. So the hard-working man still takes rest with his book in his humble, ill-ventilated domicile; or goes to the tavern for drink, laughter, and excitement; leaving out-door recreation to those whose labour is less exhausting than his own, or who have the means of riding to the distant pleasure-grounds.

340. Great as such disappointments are, they ought, on no account, to cause despair; but rather to urge the philanthropic and ingenious mind to the discovery of more effectual means for securing health and rational amusement, to the sons and daughters of mental and physical toil, in our populous towns. When we see a commercial man, either for amusement, or profit, cover an extensive manufactory of one story with a roof sustaining a garden or field—ought we not to look at the immense areas of our markets, and other public buildings of no great elevation, and generally situated in the most dense parts of our large towns, and say to ourselves, "verily, if man could make fifteen, ten, or even five per cent. by promoting the health, long life, and happiness of his neighbours, he would long since have covered these places, with a vegetable surface—ornamented with tasteful walks, lovely grottoes, oxygen

breathing plants and shrubs, or beautiful flowers, to dispense health and happiness, in ceaseless streams, to all around." A slated roof possesses no such advantages.

341. It may be long before public benevolence brings science and right principles thus practically and effectually to aid her, in doing good to society; but no one at all conversant with the organic laws of respiration, or with the sanatory condition of most, if not all, large towns, can for a moment doubt, that an incalculable good might easily be conferred in very many cases, by the adoption of such a plan. When a public garden or park is laid out, close on the border of a town which has 100,000 inhabitants, living in an area two miles in diameter; one-half the people for whom it is intended being from one to two miles distant, cannot enjoy the offered boon, except at the expense of an hour's walk, going and returning. Could such a healthful promenade be established in or near the centre of the town, two-thirds of the inhabitants would be within half a mile of it; so that those who never went to enjoy a walk with their wiser neighbours, would constantly enjoy a far more pure air for breathing; and, consequently, be much better able to avoid disease, or to bear and overcome it, than they otherwise could have been; because, the new vegetation growing in the heart of the town would absorb the superabundant carbon for its own growth, and distribute a necessary supply of oxygen, for promoting health and prolonging life, among those people who had shown so much practical wisdom as to seek health and happiness according to God's laws.

342. Let us hope correct views on this important subject will, at no distant day, become so general among all classes, that British good sense—enlightened benevolence—and commercial enterprise will be combined, to promote national health; for whenever this is the case, and we begin to obey all the physical laws of our nature, the next generation will (other circumstances being equal) exhibit a far higher standard of national health than any of its predecessors. We must not, however, conceal from ourselves the unpleasant fact, that we are still very far from

either obtaining or deserving these physical blessings. Nations, families, and individuals, have erred and gone astray from the right path so long, that it is now very difficult, in some cases almost impossible, for them to leave the evil way and become obedient to the physical laws of their nature. When individual or even national ignorance is removed, many formidable barriers still oppose the practical application of right principles, for promoting health or good morals. Unwise laws require expunging from the statute book—private or national interests demand compensation, before they will give up their vested rights in spreading or creating disease, and shortening life—and habits, however pernicious, are seldom entirely removed, except by the gradual dying away of an erring generation.

343. This may appear a very gloomy picture, but facts are too strong to admit any doubt of its truthfulness. I could give many such facts—some not publicly known, and may perhaps be pardoned for introducing one case here, which, to my mind, is, of itself, a clear illustration of the powerfully opposing forces that thwart the efforts of those who desire to improve public health and morals. The local authorities of the largest provincial town in the empire have so effectually applied their knowledge, talents, and spirit of commercial enterprise to the improvement of their town, that during the last thirty years, they have *made* a property which now produces the astonishing sum of £40,000 per annum; wholly applied by them for the widening of old, and the opening out of new streets, to admit increased traffic and better ventilation; and for draining, and in every possible way improving the healthy position and business capabilities of the town. From the municipal body, this enlightened public feeling has extended to the whole people, who have resolved to establish public parks, walks, &c., for promoting healthful out-door recreation among themselves. The voluntary subscriptions for effecting this noble purpose, already exceed £30,000, independent of present, and it is to be hoped future, aid from government.

344. Taking a strong local, as well as national interest

in this matter, I published for public approval, in December, 1844, a plan for erecting public markets on an open area containing about 12,000 square yards, near the centre of the town, formerly used as a cattle market, and covering them with a roof, so formed as to sustain a coat of soil about three feet thick; to be laid out as a garden, shrubbery, and pleasure grounds free to all the people, intersected by numerous cross walks, elevated about three or four feet on railed terraces, with glazed sides down to the roof for admitting plenty of light into the market below. Such plan to be executed jointly by the corporation and committee for establishing public parks, walks, &c., after purchasing the right to erect markets from an individual who had, till then, not seen it to be his interest to build or permit to be built, a covered market for a population of more than 300,000. All additional expense connected with the formation of a roof on this plan for promoting public health and recreation, to be paid by the committee; which might, perhaps, amount to one-tenth of the public subscriptions, the remainder being applied to establish public parks as near the town as possible, on the plan originally intended. About the same time I submitted, to the corporation and public committee, two propositions for removing every difficulty out of their way, in carrying this plan into effect. But I have no need to name them here, for, on the 24th of March, the corporation followed up their former noble efforts to confer the greatest possible amount of good on their constituents, by purchasing, for the sum of £200,000, all the property and feudal rights that had so long impeded many of their best designs for doing good to their fellow citizens.

345. May all public bodies employ their wealth, power, and talents, for equally ennobling ends—and may these enlightened, energetic, and philanthropic patriots, set before the world another example how to improve the "Health of Towns;" by establishing the first Civic Garden and Promenade for the people, according to the views and plans laid down in this and the five previous sections, modified as may to them appear best. My knowledge of the men

forming the two public bodies on whom this depends, induces me to say, that if the pleasure-grounds now being purchased, and laid out for the people, should, from any cause, ultimately be found so far out of the way of the industrious classes as only to be used by them on a Sabbath, to the partial neglect of their spiritual welfare, these benevolent men will feel great regret; however much their labours may be admired and enjoyed by the upper classes, or whatever praise may be lavished on them, in books and newspapers.

346. If our benevolence be not guided by enlightened views of the laws operating in and upon man's physical and mental nature, we shall ultimately find, "we have laboured in vain, we have spent our strength for nought." And it is the same in all matters concerning our own bodily health, mental defects, or moral misconduct; for a happy position in any, or all these respects, cannot be maintained when possessed, or regained when lost, if our knowledge of the real cause of the evil be insufficient or erroneous; or if we lack the moral courage to do that which we know ought to be done. Take, for example, the simple case of duly cleansing all the skin, as this entirely depends on ourselves; and *we* enjoy the whole reward of doing it, or bear the ills arising from its neglect. When we find that the pores of the skin by which the perspiration escapes, or ought to escape, are so numerous, that a grain of sand laid on any part, covers more than 100,000 of these pores; and that grains of sand, in countless thousands, are found in water, after the whole of the skin has been washed with it by a sponge; we shall cease to be surprised at feeling dull, heavy, and feeble; or experiencing chilling, feverish sensations, during every slight change of weather, when this necessary ablution has not been performed. And what should hinder this? Should childish fear of cold water tempt the omission, even for once? Drive it away, by thinking of the delightful glow that immediately follows a good washing and wiping; and of the firmness of muscle, the agility of motion, and the vigorous cheerfulness of spirits, which are enjoyed for a whole day by devoting

three minutes every morning before dressing to the observance of this simple duty of comfort and cleanliness during health. No medicine yet discovered confers good health and long life with so much certainty, as uniformly doing this, and taking regular exercise; and those who comply with these easy conditions, have the most just claim to enjoy such inestimable blessings.

347. If we timidly, and through cowardice, neglect to do that which we know to be our duty, whether it be in matters affecting our health, mental, moral, or spiritual improvement, or the good of others; we must take our place amongst the careless, idle multitude, who wish for, and expect happiness, but never get it; because their indolence, or their ignorance, prevents them from complying with those conditions that most uniformly secure enjoyment. A farmer does not always reap as much wheat as he wished for; but he would be thought a very simple man if he expected to reap *any* wheat, where he had sown *none*. Our most frequent and serious errors arise from ignorance—either of ourselves or others—of facts or principles. We know not what to sow; nor when, or where to sow; and consequently, many of our best advantages remain fallow, or become covered with noxious weeds, for want of proper culture. Few minds know the extent of their own possessions, or how to develope their latent powers most usefully.

348. Another very common error is, to entertain a false idea of ourselves, or fix our mind on things unworthy of our attention. Whatever we value, either from right or wrong motives, absorbs our thoughts. He who made the mind, and therefore knew it best, tells us, "where your treasure is, there will your heart be also." Besides, when we know to do right, and that we ought to do it, we often feel in an unfit state of mind for acting our part well. Truly may we all say, "I cannot do as I like, and when I like;" and it would be wise, for every one honestly to confess, with the inspired Apostle, that "when I would do good, evil is present with me;" "for the good that I would, I do not; but the evil which I would not, that I do." We

can have no well-grounded hope for any lasting improvement, till we fairly and boldly investigate the causes of our past errors: and earnestly set about removing those causes, in the way a correct knowledge of our compound nature will show to be the only human means available for so necessary and important a work. It is to be hoped, what has already been said will make this tolerably plain; and that with careful, but especially, praycrful study, the task will become more easy as we advance; each forward step strengthening the good, and weakening the bad tendencies of our naturc.

349. This, however, is far from being an easy task. Old, familiar, and constantly besetting—perhaps, dearly-loved—habits, passions, desire for gain, or ambition, may oppose its being done; and a fact or many facts, merely read in a book, soon get smothercd, by the ever-craving appetites from within, and the entreaties, flattery, or taunts, of ignorant, mistaken, and interested parties from without. It is a most sevcre trial, to change our early habits; indeed, many parties prove unequal to the effort; and allow themselves to be dragged along, in a most pitiable, helpless manner, through a short lifc of agonized conflict, to an untimely, if not an unhonoured grave. Victory may, however, generally be attained by all, if the combat is not too long deferrcd; and those who do not make this struggle for health and continued life, whcn the means are made clear and plain to them, ought not to be surprised if others, possessing a greater degree of courage and firmness, should regard them as moral cowards, or doubt their real desire to live.

350. Every enlightened mind dclights to dwell on the fact, that our blessed Creator gave us the power of holding, as it were, the helm of our physical constitution; and its laws are of such a nature, that, when this is done rightly, the whole vessel is obedient to it, and all goes on well. *We* only are to blame, if we remain in unknown, stormy seas, without compass, rudder, and pilot; when every thing necessary for our comfort and safety is so bountifully providcd. Let all who have hitherto neglectcd to use these

means of common prudence, thank God for them, take courage, and no longer trifle with the life, and health, he has, for his own wise ends, bestowed, lest his present and future punishments fall heavily upon them. Even those who have impaired their constitutions by neglecting to observe the laws of health, may do much towards restoration by prompt and thorough reform.

"You are old, Father William, the young man cried,
The few locks that are left you are gray;
You are hale, Father William, a hearty old man,
Now tell me the reason, I pray?

"In the days of my youth, Father William replied
I remembered that youth would fly fast,
I abused not my health and my vigour at first,
That they might not forsake me at last.

"You are old, Father William, the young man cried,
And life must be hastening away;
You are cheerful, and love to converse upon death,
Now tell me the reason, I pray?

"I am cheerful, young man, Father William replied,
Let the cause thy attention engage;
In the days of my youth, I remembered my God,
And he hath not forgotten my age."

SOUTHEY.

CATECHISM.

QUESTIONS ON LESSON I.

*** *To mark the close of each section its number follows the last Question upon it. Thus*—1 *follows question* 5;—2 *question* 8; *&c.*

1. Who made every thing?
2. How did he make all things?
3. What belongs to God?
4. Will any of these ever cease to be his?
5. What does he do with them?—1.
6. Are God's works like those of man?
7. In what do they differ?
8. Does God want materials to work on?—2.
9. Are some things the same now as when created?
10. Name some things our first parents had to do.
11. Is it the same now with us?
12. Whence do we get materials to make any thing?
13. Was it always so in the world?—4.
14. Whose laws should man learn?
15. What does he gain by learning any of God's laws?
16. What is man's knowledge of the sun, tide, &c.?
17. What has modern science taught man about light, moving ships, carriages, and sending messages?
18. Does man create a thing, when he finds it out?
19. What did Solomon say?
20. What then is the good done by man's discoveries?
21. How does man find out new laws of matter?—6.
22. Has man added any new property to matter?
23. Can man create new faculties of mind?

24. Can he improve those that are given him?

25. Does God ever confer the good a discovery gives to man, before some man makes it?

26. When does he confer the good on man?

26. Are his laws of use to man before man knows and obeys them?

28. Should we then learn all God's physical laws?

29. Why?

30. What is a physical law?

31. Name a few of them.—7.

32. How do animals obey God's laws?

33. Does man obey from the same cause?

34. How then does man obey?

35. What is left unexercised, when we merely do a thing from being told to do it, by somebody?

36. How is that?—8.

37. What does man's position, endowments, and destiny require of him?

38. Is it good to find out new laws of matter?

39. Who made those laws?

40. Why do they no good to man till found out?—9.

41. Then all those laws were made for man's good; a part of which good man obtains, by discovering them?

42. Do God's laws ever change?

43. Name some of them?—10.

44. Are man's laws always the same?

45. How are human laws carried into effect?

46. Will they not act otherwise?

47. With whom are God's works and laws an important object of study?—11.

48. Are you of that number?

49. Does man know all these laws without teaching?

50. What should he do, when he has learned them?

51. Always? should he neglect at no time?

52. Is it worse to disobey a law after, or before we know that law?

53. Why so?—13.

QUESTIONS ON LESSON II.

1. What two great classes include all created things?
2. On what do plants and trees feed?
3. Do these become a part of the plant?
4. How?—14.
5. Is it the same with wood, stone, and iron?
6. What is said about a table and a chair?
7. What is the general form of a stone or pebble, before it is washed down from the hills?
8. Is it still of the same form, after being rolled about, with many others, for a long time by the stream?
9. Will iron also wear away by using it?
10. Can you give an example of this?—16.
11. Then wood, iron, stone, &c., have no power to take up new matter to supply waste, or to grow larger?
12. What is said of all inanimate matter?
13. Does the same law also govern animated beings?
14. On what do vegetable substances feed?
15. Does the inanimate matter taken up by vegetables from the soil, water, and air, that surrounds them, still remain inanimate?
16. What do many animals feed upon?
17. What effects do the laws of animal life produce, from the vegetables eaten by animals?—17.
18. What is here said of man?
19. With what peculiar power is he endowed.
20. Does man gain any particular good from this power of getting a knowledge of these laws?
21. Who created, and continues, these laws?
22. Does their natural power depend on man?—18.
23. Can man deprive man of the just reward he ought to receive, for obeying them?
24. Is it right to do so?
25. Can human power destroy or subvert these laws?
26. What good does man gain by an acquaintance with the never-changing laws of his Maker?

27. Does man know all God's laws?

28. Why not?

29. What has he to do to gain a knowledge of a law not before known to man?—19.

30. Whose means of happiness does this increase?

31. What branch of earthly knowledge is most important to man?

32. To whom is this really the case?

33. Has this knowledge always been within the reach of most people?

34. Why not?

35. Have attempts been made to remove this evil?

36. When have they been made?

37. Were the attempts successful?

38. Who were the books chiefly written for; adults, or young people?—20.

39. How was the subject treated?

40. When are the laws of man's nature most active?

41. Are the consequences of disobeying those laws at that period serious?

42. More so than at other times?

43. What is said about the self-denial of pleasure?

44. And of bridling many of our strongest passions?

45. Are these things agreeable to youthful ardour?

46. How can you best submit to present restraint?

47. Is it enough to know these laws, without also being trained to obey them?

48. What great principles are intended to be explained in the following Lessons?—22.

49. In what manner is this attempt said to be made?

50. What should be our chief object, in connection with each law explained?

51. Should we try to get a lasting idea of the benefits to be thus gained, and of the ills to be avoided?

52. What shall we then know more about "chance"?

53. Why could we not see this before?

54. Is there a cause for every thing?

55. What are the chief causes of ill, to us?—23.

56. Why do we disobey God's just and holy laws?

57. Will knowledge then prevent future ill to us?
58. Could a naturally bad constitution, be restored to perfect health, by the individual becoming wise?
59. Have any means been appointed for preventing such calamities?
60. Who is to blame if we neglect these means?
61. Will you neglect getting to know, and trying to use *all* of them?—24.

QUESTIONS ON LESSON III.

1. What is man?
2. What are combined in man's structure?
3. In what way is man said to be superior to other creatures?
4. What aids much in giving this advantage to man?
5. Who originally fitted man to enjoy them?
6. On what do animals chiefly live?
7. Does this food influence them any way?—25.
8. How does it best promote health and strength?
9. Whence can man obtain food?
10. Who adapted the world for supplying it?
11. Who gave man the necessary powers to get it?
12. Is there any thing particular in the form and order of man's teeth, from those of other animals?
13. What number of teeth has man?
14. Has the first set of teeth in childhood the same number in it as the second set?—26.
15. What should we do when eating our food?
16. Why should we chew it so well?
17. Who should be most particular in doing this?—27.
18. Could they do this without, or with bad teeth?
19. Should this make us take care of our teeth?
20. Why so?
21. Is the mouth clean when we have done eating?

22. Where do little bits of food give uneasiness?—28.
23. Why are the surfaces of the grinders uneven?
24. What is their number?
25. Where are small bits of food liable to remain?
26. Should these always be cleaned away?
27. How?—29.
28. Is it well to do this before company?
29. When should the teeth be well cleaned?
30. What should they be cleaned with?
31. Any thing else occasionally?—30.
32. What is our food subject to do?
33. Is this the case before we eat it?
34. In what state will the food decay quickly?—31.
35. Is it well mixed up when chewed?
36. What promotes its decay on the teeth?
37. Is not this bad?
38. Have some people living things in their mouths?
39. Is it sufficient to clean them out occasionally?
40. What must be done to keep the teeth white?
41. Who made the laws by which food decays when it is left on the teeth?—32.
42. Are all these laws good laws?
43. Is it sinful to disobey them?
44. Does it prevent pain to obey them always?
45. Is it not then very foolish to disobey them?—33.
46. Who are fond of sweets, pastry, and such trash?
47. Does taste give nourishment to the body?
48. Who do we always find feeble and sickly?
49. Would you like to be so?
50. Can you be healthy, by always acting contrary to the physical laws of your nature?
51. What kinds of food adhere most to the teeth?
52. Then these sweet kinds of food destroy both the appetite and the teeth.
53. Will the pleasures of taste enjoyed for a short time, console you under the suffering caused thereby, or add to your pain?
54. Who gives us two sets of teeth?

55. Who is to blame if we lose them by neglecting to do those things which preserve them best?
56. Who will suffer for this neglect?

QUESTIONS ON LESSON IV.

1. When we have well masticated our food, what do we do with it next?
2. Where is the gullet?
3. Where is the stomach, and what is it for?—35.
4. What is the form of the stomach when full?
5. How is it when empty?—36.
6. What forms the gullet, stomach, and intestines?
7. What length are man's intestines?—37.
8. What is the entrance to the stomach called?
9. What is the passage out of the stomach called?
10. Does any thing guard this passage?
11. Why is it thus guarded?—38.
12. What takes place in the stomach immediately after food is swallowed?
13. Where does the gastric juice flow from?
14. What would take place if this juice did not flow, to digest the food?
15. When is this fluid chiefly discharged?
16. What change does this produce?—39.
17. Does the gastric juice mix best with solid or liquid food?
18. What effect has much fluid on digestion?
19. What becomes of the water after any food it contained has been extracted out of it by digestion?
20. Can a sponge still take up water after it is full?
21. Is the absorbing power of the capillary vessels of the stomach nearly the same?
22. If more liquid is taken into the stomach than can be well absorbed, what effect does it produce?—40.

23. What happens when pure water enters the stomach during thirst?

24. What do other liquids require, before the water of which they chiefly consist can be thus taken up?

25. What becomes of any matter they contained?—41.

26. What is alcohol or spirit found in?

27. What are its effects on organic substances?

28. Has it the same influence in the stomach?

29. Would you like the food you eat preserved?

30. Could the body be duly nourished and supported if our food remained undigested?—42.

31. What is said to be a very wonderful process?

32. Is man likely to invent any plan for digesting his food before eating it?

33. If such a discovery was made, in what cases would it be useful?

34. Can we assist the stomach in digesting our food by thinking about it?

35. What will prevent food from being digested in a healthy stomach?—43.

36. How can you show the process of digestion?

37. What effect takes place on the hard lime soon after being placed in the water?

38. Could water or lime be used alone for the same purpose as both can, when formed into one substance?

39. Will gastric juice or food alone nourish the body, without being united into one substance?

40. What is digested food called?—44.

41. Is a meal immediately changed into chyme?

42. What effect does taking too much food produce?

43. What is the effect of taking too little food?

44. What is the consequence of allowing the stomach to remain long empty?

45. Is it well to eat in a great hurry?

46. Should the food be well masticated before going into the stomach?

47. Why so?—46.

QUESTIONS ON LESSON V.

1. What should we do after eating when we are weak and tired?

2. Does any thing make this still more necessary?

3. Should mind and body then rest after eating?

4. Does it take much strength to supply gastric juice to digest food well?—47.

5. Are we conscious of this by our own feelings?

6. What will follow our working immediately after eating, when nature's powers are very feeble?

7. When we are weak then, we cannot well do two things at once?—48.

8. Is violent exercise good immediately after eating?

9. Can you give an example of its ill effects?

10. Who tried the experiment with two greyhounds?

11. What did the physician do with the dogs?

12. Which dog had digested the food given it?

13. Why had running prevented digestion in the stomach of the other dog?—49.

14. What effect has cheerful talk after eating?

15. Does laughter over wine promote digestion as much as that proceeding from natural gladness of heart?

16. How can a hearty laugh promote digestion?

17. How can invalids also promote digestion?

18. Should we sleep soon after eating?—50.

19. What kind of food is longest in being digested?

20. Whether does a well or ill masticated dinner digest soonest?

21. Is digestion equally good in all stomachs?

22. Or, in the same stomach at all times?—51.

23. What is said about digesting the skins of fruit?

24. How long is a mother's milk before it begins to be digested after entering the stomach of her babe?

25. Would the mother's milk digest as soon in the stomach of one of her grown up children?

26. Can the gastric juice digest things that are alive?

27. What does it sometimes do after death?—52.
28. Have all these facts been known long?
29. Who has contributed most of this knowledge?
30. By what means has he done this?
31. Who was shot in the stomach?
32. Did the wound heal in the usual way?
33. How, then?
34. Did it leave a passage into the stomach?
35. Could things be put in or taken out?—53.
36. Who put it into the mind of this American to do so much good to his race?—54.
37 What is said of the ways of God's providence?
38. Does he sometimes employ apparently humble means for effecting his great ends?
39. Are our duties the same after as before God in his goodness thus reveals to us the mysterious workings of his great and unchanging laws?
40. When is our duty to obey these laws increased?
41. Repeat the concluding text?—55.

QUESTIONS ON LESSON VI.

1. What is supposed to have been well done in the beginning of this Lesson?
2. What state should we be in to make sure of these processes being well done?
3. What is said of a valve or door?
4. What inquiry do we now pursue?—56.
5. Which way does *chyme* pass out of the stomach?
6. Can you name the valve which permits it to pass?
7. Where does chyme go on leaving the stomach?
8. Where does the chyme soon arrive?
9. What does it receive here?
10. Whence comes the bile?
11. Whence comes the pancreatic juice?—57.
12. Why are these two fluids poured into the chyme?

13. What effect do they produce in the chyme?
14. Where does it soon arrive?
15. Are there any passages out of the jejunum?
16. Can you give their name?
17. What are they for?
18. Can you tell me why a chemical action was caused in the chyme by the bile and pancreatic juice?
19. Do you now begin to see any particular object in all that you have previously described?—58.
20. What are the *lacteals* for?
21. Do you still call the fluid they have received from the intestines, chyme?
22. What does *chyle* pass through in the mesentery?
23. Where does chyle go, on leaving the mesentery?
24. Does it meet with any other fluid in the receptacle of the chyle?
25. Where does *lymph* come from?—59.
26. What colour is chyle after it receives lymph?
27. Where does the chyle go next?
28. How thick is the tube called the *thoracic duct?*
29. Which way does this tube go?
30. Does it pass alongside of some particular artery?
31. Into what vein does it pour the chyle?
32. Is there any particular bone over the place where the chyle thus enters the venous blood?—60.
33. Can the food and drink we take give us strength in any other way than by going through this process?
34. What is the blood here called?
35. Is it important each part of the process, by which our blood is made, should be well understood?
36. What is shown in Fig. 2, to make this clear?
37. Is any particular instruction given about the position of this, and all the other figures, used to illustrate the various Lessons?—62.
38. Is Fig. 2, here used for any other purpose?
39. What is the stomach said to be doing?
40. Through what valve do its contents pass?—63.
41. At which extremity of the stomach is it placed?

42. Name the first portion of the intestines?

43. What are next seen, distilling their juices into the chyme?

44. Name the second portion of the intestines?

45. Is it remarkable for any openings in it?

46. Are they small or large?

47. What are they for?

48. Can you tell their names?

49. What do they absorb from the chyme?

50. What becomes of the chyle after it is extracted by the *lacteals* from the chyme in the *jejunum?*

51. Does any change take place in the chyle, while passing through the mesentery?

52. Where does the chyle go next?

53. Do you recollect what colour it becomes, in the receptacle of the chyle?

54. Is it joined by any other fluid here?

55. Which way does the chyle go now?—64.

56. What does the thoracic duct do with the chyle?

57. Is digestion alike in all persons?

58. What is said of the ploughman?

59. What is said of the dyspeptic invalid?

60. Whose stomach is difficult to stay?

61. Whose appears almost dormant?—65.

62. Is the proportion of matter taken up from the chyme by the lacteals always the same?

63. What is said of the gluttonous gourmand?

64. Is any remark made of the hard-working man?

65. What is said about cases of actual starvation?

66. Can you name two cases here said to be hurtful?

67. Which of them is painful and soon fatal?

68. What is said about gluttony?—66.

69. What is the effect of forcing nature too far?

70. Can health and strength be secured by always taking a proper proportion of food and drink?

71. What is said of a due supply of these?—67.

72. Can chemists detect any difference in chyle made from rich or from poor food?

73. What is nature here said to do?

74. Can you tell me any thing particular about a penny dinner of potatoes?

75. What is said of the guinea dinner?—68.

76. Is any thing said of the chyme not required for any purposes of health and strength?—69.

77. What is said about the laws that regulate and govern all within us?

78. What is the valve?

79. Can you tell the properties of the juice and bile?

80. What are the minute vessels said *only* to do?

81. Is any thing said about ten thousand tubes?

82. Can you repeat the two questions which conclude this Lesson, or their meaning?—70.

QUESTIONS ON LESSON VII.

1. What is now to be shown about the blood?

2. What may it be said we have already seen?—71.

3. Is blood like that from which nature makes it?

4. How many kinds of matter does blood contain?

5. What else is named as consisting of 26?—73.

6. When shall we cease to be surprised at so many kinds of matter being in the blood?

7. What proportion of water does it contain?—74.

8. What is the second substance named?

9. What is its appearance?

10. In what does it seem to float, after blood has been some time cool?

11. What does the clot contain?

12. What is made from fibrine?

13. Does the clot contain any thing else?

14. What does serum consist of?—75.

15. When was a large proportion of the clot said to be in a liquid state?

16. What is observed in blood with a microscope?

17. What do the numerous small globules float in?

18. Can you tell what causes the colour of the blood?

19. Of what form are the red globules?

20. Can you state about what diameter they are?

21. What has science been able to do at them?

22. What is found inside these minute globules?

23. How big are the white grains found inside them?

24. What do they slightly differ from in the kind of matter they contain?—77.

25. What proportion of the blood is water?

26. What proportion is hæmatine?

27. What proportion is albumen?

28. How much fibrine does the blood contain?

29. What proportion is crystallized fatty matter?

30. What proportion is oily matter?

31. What proportion is extractive matter, soluble in alcohol and water?

32. How much is albumen combined with soda?

33. How much is chloruret of sodium and potassium, alkaline phosphate, sulphate and sub-carbonate?

34. What proportion is sub-carbonato of lime and magnesia, phosphates of lime, magnesia and iron, peroxide of iron?

35. What proportion of other substances?—78.

36. Are all these substances necessary in the blood?

37. What is said about bone and flesh, muscle and fat, tendon and nerve, nails and hair?

38. Are these all made from the blood?

39. Could they all be made of one kind of matter?

40. Are you still surprised at so many kinds of matter being in the blood?—79.

41. Do you think it necessary for health, that each substance should be in the blood in due proportion?

42. From whence can nature obtain them?

43. What is the consequence of their not being supplied in due proportion?—80.

44. Does forcing too much on nature do harm?

45. What also produces nearly the same effect?—81.

46. Are all kinds of matter the blood contains in small particles?

47. What good does this do?—82.

48. What would be the effect of this not being so?

49. What reflection does a consideration of all these arrangements for our health and happiness produce?

50. Repeat the two questions ending this lesson?

51. What answer do you give to the first of them?

52. What do you reply to the second question?—83.

QUESTIONS ON LESSON VIII.

1. From whence does the blood flow?

2. Is it made there?

3. How then does it enter the heart?

4. How does it leave the heart?

5. Into what does the blood flow from the heart?

6. What name is given to the tubes or vessels through which the blood flows back to the heart?

7. Have you any particular name for this flowing of the blood to and from the heart?—84.

8. Can you tell me the form of the heart?

9. Are its sides round or flat?

10. Is it thickest at the top or bottom?

11. What colour is it, white, black, or brown?

12. Where do you often see hearts hanging up?

13. To what animals did they once belong, think you?

14. Is the heart a solid body?

15. How many hollow places are there in it then?

16. What are they called?

17. Are there any openings or doors in them?

18. How many in every human heart?—85.

19. What names are given to the two veins by which the blood passes from all parts to the heart?

20. What part or cavity of the heart do they discharge the blood into?

21. What is there at the mouth of each vein?

22. Are these valves formed in any particular way?

23. Will they let blood come out by the way it enters the heart?—86.

24. What forms the inner boundary of the right auricle of the heart?

25. What does this partition contain?

26. What is this valve for?

27. What is the cavity called into which the blood enters, through this valve?

28. Where does the blood now go from the heart?

29. What does it pass through in going from the right ventricle to the lungs?—87.

30. When the blood has done its offices in the lungs where does it go?

31. How does it return to the heart?

32. Which side of the heart does it enter?

33. Name the cavity that now receives it?—88.

34. What is the fourth cavity in the heart called?

35. How does the blood pass from the third to the fourth cavity?

36. Is this valve in a thick or thin wall?

37. Why is this the strongest part of the heart?—89.

38. What organ of the body is most necessary?

39. Which is least under the power of the will?

40. Is the heart often diseased?

41. What protects it from accidents?

42. Where is the heart situated?—90.

43. In what peculiar manner are its valves formed?

44. Why are the *aorta* and branches called arteries?

45. Of how many coats are they formed?

46. Which of these coats is the least elastic?

47. How does this sometimes prevent death?—91.

48. Are the arteries important vessels?

49. How does nature protect them from injury?

50. Do they run crooked in the body?—92.

51. From whence do the arteries spring?

52. In what form does the chief artery rise and proceed on its course?

53. What are the first branches it sends off called?
54. To where do they go?
55. Where do the subclavian arteries go to?
56. To what part do the vertebral arteries go?
57. Where does the main artery now pass down?
58. What does it pass through?—93.
59. Where does the chief artery divide into two?
60. What is sent off along the course of the arteries?
61. What are small arteries sent off for?
62. What parts do they supply with blood?
63. Can any part get blood from other sources?
64. Do the arteries get smaller as they extend?
65. What are they likened to?—94.
66. In what class of vessels do they terminate?
67. Where do we next find the blood?
68. What do the veins do with the blood?
69. Where do they terminate?—95.
70. Of how many coats are the veins formed?
71. Are they as elastic as those forming the arteries?
72. Is there any thing in the veins besides blood?
73. Why are these valves formed in the veins?—96.
74. Do veins and arteries run near together?
75. Which of them bring blood from the heart?
76. Is there any difference between blood in the veins, and that in the arteries?
77. Which contains the bright red blood?
78. Is arterial blood in the lungs the same colour?
79. Where shall we see the cause of this?—97.

QUESTIONS ON LESSON IX.

1. Do you clearly understand the way in which blood is made?
2. Does it contain various kinds of matter?
3. How many?
4. In what vessels does it move to and from all parts?

5. Knowing these things well, what are we better prepared to do?

6. Is it important we should understand this?—98.

7. At what point of the circulation shall we begin?

8. What does section 60 tell us?—99.

9. How shall we best make the course of the circulation clear?

10. Does this figure show the circulation of the blood just as it is in the body?—100.

11. Which point do we now commence with?

12. What are the two great veins said to do?

13. How do they pour the blood into the heart?

14. Into what part of the heart?

15. Where does blood go from the right auricle?

16. Through what does it pass?

17. Could it come back that way?—101.

18. What occurs in the right ventricle of the heart every time it is full of blood?

19. Which way does the blood then pass?

20. Is the blood sent to every part of the lungs?

21. For what purpose?—102.

22. In what do the branches of these arteries end?

23. What takes place in the pulmonary capillaries?

24. How thick are the coats of the air-cells?

25. What passes through them out of the blood?

26. What passes out of the air into our blood?

27. Do these causes produce any change in the appearance of the blood?—103.

28. What purpose is the blood now fit for?

29. What vessels receive the blood from the pulmonary capillaries?

30. Are they small or large?

31. Do they continue thus small?

32. Where do the pulmonary veins take the blood?

33. How do they discharge it into the heart?—104.

34. What part of the heart does it now enter?

35. Does it remain long there?

36. Where does the blood now pass to?

37. How does it pass from the left auricle?

38. Can it return again the same way?—105.
39. What takes place when the left ventricle is full?
40. What does the lowest point of the heart do?
41. Does any thing now pass out of the heart?
42. From what part of the heart?
43. Where does blood go from the left ventricle?
44. Which is the strongest part of the heart?
45. Why is it the strongest?—106.

QUESTIONS ON LESSON X.

1. What does each tidal gush of blood do?
2. Under what three forces is the blood urged on in its course through the arteries?
3. Name the first, the second, and the third?
4. Is the sudden impulse of the heart felt anywhere?
5. What use do medical men make of the pulse?
6. How often should it beat in a minute?—107.
7. When is blood sent to the lungs?
8. Why is it sent to the lungs?
9. Of what particular form are valves in the heart?
10. What are their duties?
11. Do they perform those duties well?
12. What, both while we are sleeping and waking?
13. Do we need to tell them to do their work?
14. Do you perform all your duties so well?
15. Why not?—108.
16. What do all the arteries terminate in?
17. What do these capillary vessels form?
18. What is their duty and office?
19. Do they give the right kind of matter to each?
20. Have you read again sections 73 to 83?
21. Whence does nature get all her supplies for sustaining and building up the body?—109.
22. Can she draw support from any other source?
23. What is here said about our bodies?

24. What is said of each pulsation?

25. What kind of matter is sent to each part?—110.

26. Does any thing else take place while the blood is in the capillary vessels?

27. What does the blood receive?

28. What then becomes of these waste particles?

29. What is said about blushing?—111.

30. Is the blood long in the capillary vessels?

31. What vessels is the blood now seen to enter?

32. Are they large or small here?

33. Has the blood still the same appearance it had?

34. Is it still fit for the purpose of life?—112.

35. What are the veins like at first?

36. Do they continue so fine?

37. How does the blood flow in the veins?

38. What now becomes of all the blood?—113.

39. What does this appear much like?

40. What is a main pipe for?

41. What is a small pipe for?

42. What is this similar to?

43. Where do we next find the water?

44. Is it still as pure as before?—114.

45. About how often does the pulse beat each twenty-four hours?

46. About how much blood passes through a man's heart in that time?

47. What is now our reflection?

48. Do these feelings fill your mind?—115.

49. What tends to increase these feelings?

50. When was the circulation of the blood first made known to man?

51. Whom did God make the means of its discovery?

52. Did Harvey cause the circulation of the blood?

53. Then he found out that it *did* circulate?

54. When did he first teach this?

55. How was his teaching received?

56. Was this right or wrong?

57. Could we have heard or read of the circulation of the blood had we lived before 1616?

58. What feeling should this cause in our minds?
59. Is that the case?
60. What is said of our responsibilities?
61. Repeat the two last questions of this lesson.
62. What answer can you give to the first of them?
63. What do you say to the last question?—116.

QUESTIONS ON LESSON XI.

1. Which is one of the most constant signs of life?
2. What do few people know?—117.
3. What do many think their breath is only to do?
4. What must we first do to understand this clearly?
5. What is employed in respiration?
6. Where does the breath pass down?
7. Is it a firm tube?
8. What is it composed of?
9. Where is it situated?—118.
10. Is there any thing at its lower end?
11. What are the lungs for?
12. Of what do they consist?
13. How are they fed with air?
14. Are the lungs filled with air like a bladder?
15. Is the air in the lungs in one or many parts?
16. Are the lungs filled with air in every part?
17. What are the ends of the air-tubes like?
18. What do they terminate in?—119.
19. How large are the air cells?—120.
20. Where do we get the air we breathe?
21. How high does the atmosphere reach?
22. Can we see the air we breathe?
23. Is the vapour you sometimes see in breath, air?
24. Can we feel it?
25. What kind of substance is the air?
26. What is it of vital importance to?
27. Of what kinds of matter is it made?—121.

28. Are any other substances ever found in it?
29. What does it receive from land and water?
30. What does it receive from plants and vegetables?
31. Whence does it receive noxious vapours?—122.
32. In what state is it after crossing a sandy desert?
33. What may we say the air generally consists of?
34. What proportion of *Nitrogen* does it contain?
35. What proportion of *Oxygen?*
36. How much *Carbonic acid* gas?
37. Is air in a close hot room thus composed?
38. What kind of air have we been describing?
39. Does air fill most space in hot or cold weather?
40. What expands air?—123.
41. Is air still the same after it is breathed?
42. What does it lose in being breathed?
43. What does it receive while in the lungs?
44. Has it gained any thing else?—124.
45. Can you prove expired air has been altered?
46. What sort of water would you prove this with?
47. What would you first do with the water?
48. Does it change by blowing unbreathed air in it?
49. What effect does blowing your breath into the lime-water produce?
50. Why does it cease to be clear as before?—125.
51. What changes little in the air we breathe?
52. Will nitrogen sustain animal life?
53. What takes place when oxygen is used from air?
54. Is any thing here said to be fatal poison?
55. What law is here certain?—126.
56. How much air does a man take at one breath?
57. Does he take no more than a pint in sighing?
58. Why does he take more then than usual?
59. How much air does a man breathe in 24 hours?
60. What can we learn better now?—127.

QUESTIONS ON LESSON XII.

1. Where does every breath we draw go?
2. About what size are the air-cells in the lungs?
3. Of what are these cells formed?
4. What is the skin forming the air-cells covered by?
5. What do these fine threads contain?
6. Where does this venous blood come from?—128.
7. What takes place when air enters the lungs?
8. What does oxygen pass through to enter the blood, and carbon to leave it?
9. Does this make any change in the blood?—129.
10. Where does blood go when thus changed?
11. What then becomes of the air?
12. What is said about streams of blood and air?
13. Did you read secs. 101 to 113 over again?—130.
14. What do you take out of air by breathing it?
15. Is it good to breathe air after it has lost its oxygen?
16. What do we put into air by breathing it?
17. Is it good to breathe air that is full of carbon?
18. In what state is air in a close room or populous town, where many people, cattle, &c., are breathing?
19. Who does, and ever will, do all things well?—131.
20. Do vegetables take any thing out of the air?
21. What do they set free when they absorb air?
22. Is the air better then for man to breathe?
23. Who made winds to blow?
24. Can you name any particular good they do?
25. Do they improve man's health?
26. What return do some men make for this?—132.
27. Can you name any other law of respiration?
28. When we take oxygen out of the air we breathe, how much carbonic acid do we put in the place of it?
29. How much oxygen do plants set free in the air from which they take the carbonic acid?
30. Who then mutually purify air for each other?
31. Could animals exist if there were no vegetables?

32. What promotes the health of both animals and vegetables?—133.

33. Is it pleasing to see so many of God's laws work together for good to man?

34. What does man expire into the air?

35. Is this matter made use of afterwards?

36. What distributes oxygen and carbon over every part of the earth?—134.

37. Do we always use an equal quantity of oxygen?

38. Does a citizen use most oxygen when at home, or in the country?

39. When do we use most oxygen from air?—135.

40. What do all these laws and facts prove to us?

41. What needs preparing for its office in the lungs?

42. Will bad air do this well?

43. Can it be well done, if we prevent air from going freely into the lungs?—136.

44. What should we do to get fresh air?

45. Should the rooms we occupy be aired or not?

46. What do we require when sleeping?—137.

47. Can we have good air with close bed-curtains?

48. What situation should we avoid if possible?

49. Is it well to allow any thing to remain near our home that will make the air foul?

50. Why should we often walk out?—138.

51. What are these means well adapted for?

52. In what part of a town do most deaths occur?

53. Is there any difference in the healthful tendency of employments?

54. What kinds are the best for health?—139.

QUESTIONS ON LESSON XIII.

1. Is it enough that we try to get pure air to breathe?
2. What else should we do?
3. What is it very fashionable to do?

4. This matter should then be made very plain?
5. What shall we afterwards have to choose between?
6. What is said of the god of fashion?
7. Does the Lord of heaven and earth change thus?
8. What is here said of Him?—140.
9. What are the lungs chiefly composed of?
10. What takes place when the lungs receive air?
11. What is said to be the extent of surface of the inside of all the air-cells?—141.
12. What are you advised to do that you may get a clear idea of the nature and offices of the lungs?
13. In what state is it best to get the lungs of a sheep?
14. If we cannot get them warm, what then?
15. What is their general colour?
16. Is any thing with the lungs?
17. By what is the heart suspended?—142.
18. What effects does blowing a breath of air into these lungs produce?—143.
19. What takes place on letting the air out again?
20. Is doing this often like any natural action?
21. How can you see the air-tubes and cells?—144.
22. What should be done next?
23. Can you blow air in as well as before?
24. Is it possible to fill all the cells with air now?
25. What is the effect of pressing the lungs?—145.
26. How is the human chest formed?
27. What does it contain?
28. Is the top or bottom of the chest widest?—146.
29. Do you think any body's chest is made too large?
30. Did you ever see any one tie their chest up?
31. Could they breathe as well, think you?—147.
32. What is thus crushed together?
33. Do not you shudder to see such deformity?
34. Can you repeat the questions in this section?
35. What answer do *you* make to them?—148.
36. Is it a sin thus to deform our bodies?
37. What are the effects of tight lacing?
38. Do we grow as well with impure as pure blood?
39. What lessens the ill effects of this practice?—149.

40. What is here said to be impossible?—150.

41. Can those who are laced tight make any sudden effort as well as if they allowed their lungs fair play?

42. What often causes fainting?

43. How can you prevent a horse from kicking?

44. Why will this chain prevent it?—151.

45. Why do those who lace tight generally faint in a crowded room?—152.

46. What effect is produced on those vessels that are thus prevented from doing their natural duty?

47. What often causes consumption?—153.

48. What should death in these cases be called?

49. Tell us now, whom *you* will serve and obey?—154.

QUESTIONS ON LESSON XIV.

1. Why should we pause here a little?—155.

2. What have we seen of the laws of God?—156.

3. By whose will and laws do our bodies grow?

4. Why does clothing keep us warm?

5. Could it do so unless God had made this one of his natural laws?

6. Who orders every breath we draw?—157.

7. Can we alter or mend these laws?

8. Can you remember this when you are tempted to disobey any of God's laws?—159.

9. What does section 159 tell you to do?

10. Well, let us hear you then?

11. What answer can *you* give to the two questions in this section?—159.

12. What are we quite certain of?—160.

13. What have we thus far been chiefly doing?

14. In what does man differ little from animals?—161.

15. What must we now proceed to do?

16. How is man a sensible being?

17. How is man a rational being?

18. What enables man to reason on things?—162.

QUESTIONS ON LESSON XV.

1. By what means can you feel any thing?
2. Can things that have not life feel?—163.
3. What is the cause of this difference?
4. Which is the organ of sensation?
5. What are nerves for?—164.
6. What do they contain?—165.
7. What may a nerve be compared to?
8. Of what kind of matter do the nerves consist?
9. How do they generally run in the body?
10. Are both cords of a pair of nerves alike?
11. Who made this discovery?—166.
12. Where is the brain? and what does it consist of?
13. What protects and covers it?
14. Of what colour is it?
15. Are there any cavities in it?
16. Do these cavities contain any thing?—167.
17. From whence does the spinal cord descend?
18. What may we consider this as being?
19. Name one of the most important things belonging to the nerves.—168.
20. What are the largest class of nerves for?
21. What is the optic nerve for?
22. What does the auditory nerve enable us to do?
23. What gives us the sense of smelling?
24. Is it certain what nerve gives us taste?—169.
25. Name the upper part of the spinal marrow.
26. Name the upper and largest part of the brain.
27. Where is the *cerebellum?*—170.
28. Can you make out the nerves on Fig. 10?—171.
29. Which sense may be considered the most curious?
30. Can you describe how it is we see things?
31. What is half an inch in diameter?
32. What is the 5000 part of an inch broad?—172.
33. What is the external ear for?
34. What fills the drum of the ear?

35. How is sound conveyed to the brain?—173.
36. What may we consider taste and smell to be?
37. Where do the ends of the olfactory nerve ramify?
38. How is the sense of smell conveyed to the brain?
39. Where does the nerve of taste ramify?
40. How do we feel the sense of taste?—174.
41. What is here said God has done for us?
42. What is treasured up in the brain?—175.
43. For what purpose is this done?
44. Is the organ of mind like a common storehouse?
45. Why do you think it is not?
46. What does it consist of then, think you?—176.
47. How many of these organs are in the brain?
48. What science teaches this?—177.
49. What is sufficient for our present purpose?
50. What is God here said to have given us?
51. Are feet for the same purpose as hands?
52. Do we love with the same mental powers we hate?
53. Have you a *will* to use either the good or the bad powers of your mind?
54. Which is the most sure way to be happy here?
55. What should be properly trained and used?—178.
56. Can you repeat what is said in section 179?
57. What say *you* to the question "Will you"?
58. What is said of the next three lessons?—179.

QUESTIONS ON LESSON XVI.

1. What is supposed in the beginning of this lesson?
2. What do we now proceed to do?—180.
3. What is here said about food and eating?
4. Why should meals be regular?
5. When ought our food to be most nutritious?—181.
6. What is said about drink?
7. Which is the best rule for drinking?
8. What is said of water and milk?

9. Why should spirits *not* be drunk?—182.
10. What is as needful for health as food and drink?
11. Why is exercise so necessary?
12. Cannot the blood be oxygenated by breathing quickly, without taking exercise?—183.
13. What is the effect of those who take little exercise making any sudden exertion?
14. Is a well exerted body liable to this evil?
15. What is labour here said to be?—184.
16. What have those to do who need not to labour?
17. What should be often done to the skin?
18. When is it best to sponge all the skin?
19. What effect does this produce?—185.
20. What is here said of rest, amusement, and sleep?
21. What ill effects are certain to come in time?—186.
22. What parts of the body do all these laws affect?
23. If a limb be long unused, what harm is done?
24. Can you give any example of such a case?
25. What flows freely to a well-used limb?
26. Does this produce any good effect?
27. What should we take care not to do?—187.
28. Can you give any examples of these laws?
29. Do these parties become active or strong by regular or by occasional labour?
30. What have they to get a proper supply of?—188.
31. What is youth the best time for?
32. What comparison is made here?—189.

QUESTIONS ON LESSON XVII.

1. WHAT applies with equal or greater force to the mind than to the body?
2. Where is the organ of mind situated?
3. What partakes of the same qualities as the brain?
4. May we expect to find a good, strong mind, in a weak, idle brain?—190.

5. Is each organ of the brain governed by these laws?
6. What is the brain made from?
7. What is said of strength, activity, and dulness?
8. What do some people use for bad purposes?—191.
9. Did you ever see a giant or a dwarf?
10. Do you think there are also great and little minds?
11. Can you give any examples of them?—192.
12. Where do the best powers of the mind dwell?
13. Can we ensure their growth and activity?—193.
14. Can the minds of idiots be improved?
15. Is this often the case?
16. Why are they not improved?—194.
17. What answer can you give to the two questions?
18. How can the most feeble powers be improved?
19. Whom has God set over you to guide you?
20. What is lost for ever, if once lost?—195.
21. What ought you now to exclaim?
22. Have you neglected, or disobeyed God's laws?
23. What would you like your teacher to do now?
24. Do you really wish to improve your mind?
25. Can you do this by other people's help *alone?*
26. What else is required?—197.

QUESTIONS ON LESSON XVIII.

1. What should be done first?
2. Can you tell why you have thus far done so little to improve your mind?
3. What is now partly removed?
4. What does a close examination show you?—198.
5. What has God, for wise purposes, given you?
6. Is it easy to subdue these animal passions?
7. Under what control should they be kept?—199.
8. Why has God made it pleasant for us to eat?
9. Are we sent here only to eat and drink?
10. Which is according to God's law?

11. Would any ill follow perverting these laws?—200.
12. What is here seen to be necessary?
13. How should moral control be exerted?
14. Does any feeling ever oppose moral control?
15. Which power should be the master?
16. What fact should be kept always in mind?
17. What follows the exercise of any animal passion?
18. How do the moral powers become weak?—201.
19. Can you give a reason why the mind admits of so much improvement in youth?—202.
20. What causes a healthy flow of blood to the brain?
21. Does this produce any good effect?
22. What can grow quickly or slowly?—203.
23. Can it do so through life?
24. Why does this power of improvement cease?
25. What should be done before it ceases?
26. What powers of the mind should be cultivated?
27. Which should be kept under restraint?—204.
28. What is the consequence of your neglecting this?
29. Does much harm follow our over-indulgence of the animal propensities?
30. For whose hands would this be making rods?
31. Would he *use* the rods you make for him?
32. Through what medium would he use them?—205.
33. What should we now hope?
34. Whose blessing will be necessary?
35. On what human means should we ask this blessing?
36. What have we been trying to make plain?—206.
37. What should never be forgotten?
38. What kind of obedience is not enough?
39. Is there any thing God will not have?
40. Should all God's laws be kept by every one?
41. How long should they be obeyed?—207.
42. What cannot man do for man?
43. Is any one exempt from obedience to God's laws?
44. What must all do, who wish to be happy here?
45. What should be duly exercised every day?—208.

46. Are not those very easy conditions?
47. What does God seem to say to man?
48. What is at first hard to our carnal nature?
49. Will it continue so, if we persevere?
50. What should now be our earnest prayer?—209.

GENERAL INDEX.

THE END.

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